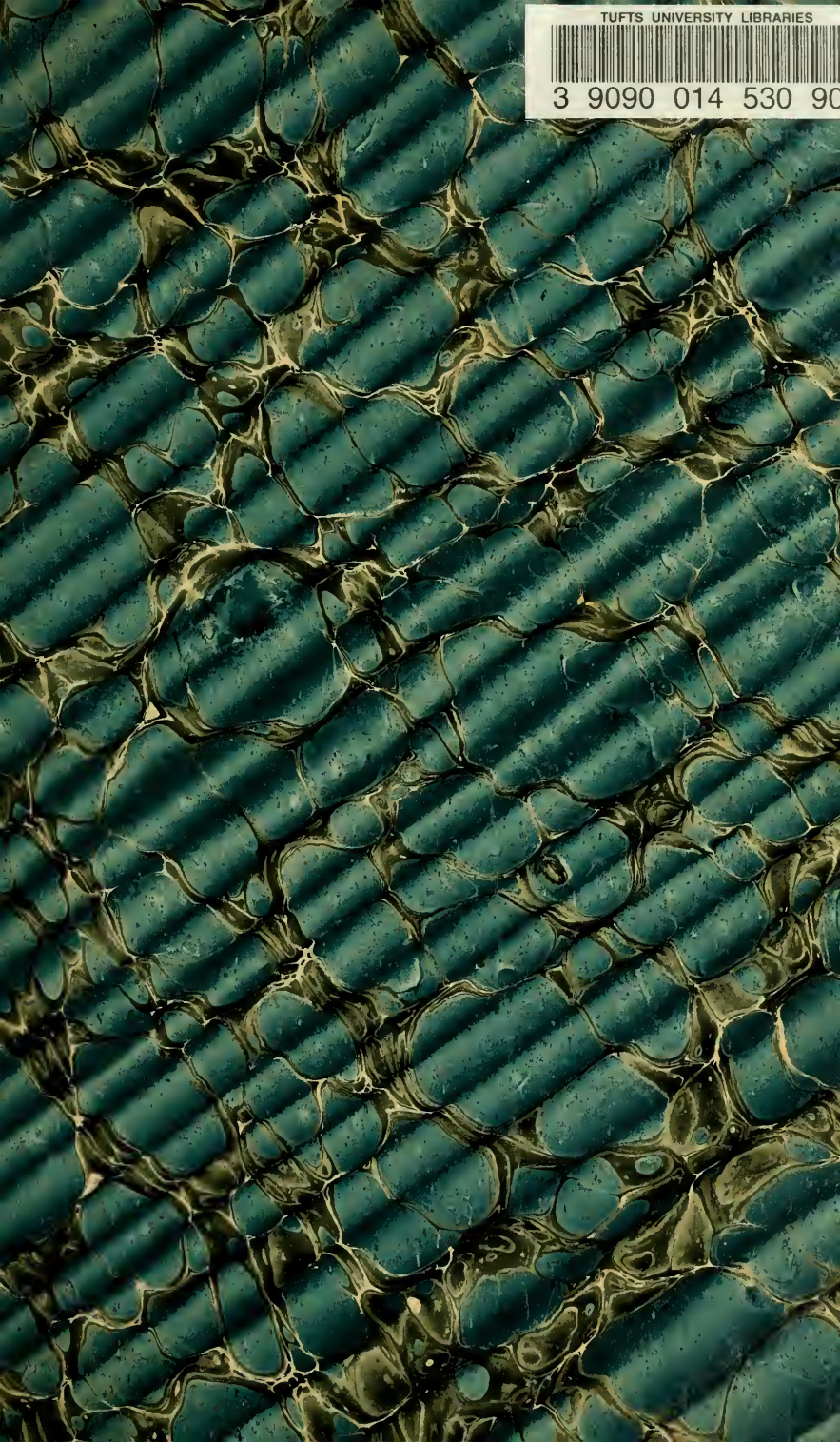
JOHN A. SEAVERNS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A MANUAL OF

VETERINARY SANITARY SCIENCE

AND POLICE:

EMBRACING THE NATURE, CAUSES, SYMPTOMS, ETC., AND THE PREVENTION, SUPPRESSION, THERAPEUTIC TREATMENT, AND RELATIONS TO THE PUBLIC HEALTH OF THE EPIZOÖTIC AND CONTAGIOUS DISEASES OF THE DOMESTICATED ANIMALS; WITH A SCHEME FOR A VETERINARY SANITARY ORGANIZATION, OBSERVATIONS ON THE DUTIES OF VETERINARY INSPECTORS, LEGISLATIVE MEASURES, INSPECTION OF MEAT AND MILK, SLAUGHTER-HOUSES, ETC.

AND AN APPENDIX CONTAINING THE CONTAGIOUS DISEASES (ANIMALS) ACT AND REGULATIONS.

BY

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IN TWO VOLUMES.

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R. Lovell Jun—
Veterinary Surgeon
Albany N. York
1878

Dedicated to

JOHN WILKINSON, Esq.,

PRINCIPAL VETERINARY SURGEON TO THE BRITISH ARMY,

WHOSE UNCEASING ENDEAVOURS TO INCULCATE

AND ENFORCE

THE PRINCIPLES AND PRACTICE OF VETERINARY SANITARY SCIENCE,

HAVE ALMOST SUPPRESSED CONTAGIOUS

AND OTHER MALADIES AMONG ARMY HORSES,

AND WHOSE ESTEEMED FRIENDSHIP DURING HIS MILITARY CAREER

THE AUTHOR HEREBY MOST GRATEFULLY

ACKNOWLEDGES, IN THIS ATTEMPT TO ELEVATE VETERINARY

MEDICINE TO ITS PROPER POSITION.

PREFACE.

At a period antecedent to the Cattle-plague invasion of 1865, the subject of contagious diseases among the domesticated animals, and the great losses and embarrassment they were inflicting upon this and other countries, had seriously attracted my attention, and engaged the hours I had to spare from professional and other duties.

A resolve to write a complete treatise upon them resulted in the appearance, in 1871, of "Animal Plagues: their History, Nature, and Prevention," which was intended to be the first of three volumes devoted to this subject. It contained a chronological history of these maladies from B.C. 1490 to A.D. 1800, with a notice of concurrent diseases in the vegetable kingdom and in the human species, and a glance at such terrestrial and celestial phenomena as preceded or accompanied these events, and were often supposed to favour their occurrence. Circumstances have retarded the completion of the volume which was to continue this history from the commencement of the present century

up to 1874; but the extensive prevalence of Rabies among dogs in the North of England since 1870, and the lamentable consequences and dread occasioned by the outbreak, induced me to select that terrible malady from the number I had included in my list of contagious diseases, and publish a monograph on it ("Rabies and Hydrophobia," London, 1872).

The present is that which was to have formed the concluding volume of the number intended to embrace everything connected with these spreading diseases among animals: including their history, geographical extension, causes, symptoms, pathological anatomy, all the facts connected with their contagious properties, etc., the sanitary and legislative measures necessary for their prevention or suppression, their relation to the public health, and the inspection of meat and milk, as well as of the establishments in which animals are killed and their carcasses utilized. With the exception of the history, which is only partially noticed for the centuries preceding the nineteenth (being already given in "Animal Plagues"), these different subjects are treated in this volume, in the preparation of which every effort has been made to render it complete and unique.

Though the most destructive contagious diseases have prevailed among animals in these kingdoms since

1839, strange to say, no attempt has been made to elucidate their nature and group them in the manner now ventured upon; indeed, but little has been published in this country relative to these maladies, and still less as to their prevention; and that little is either scarcely available for the general reader, student, veterinarian, and those most concerned, or it is not in accordance with the results of recent scientific research. Works on Veterinary Sanitary Science have been published at different times on the Continent, but none have appeared in England; though few countries have been more severely scourged in recent years by contagious diseases, and none has greater need for their prevention and suppression. It is needless in this place to dwell on the causes which might be enumerated to account for this omission.

The work is divided into four sections or parts. The first of these is devoted to a consideration of the Nature, Causes, etc., of Epizoötic and Contagious diseases. The second treats of the prevention and suppression of these maladies, and more especially of Legislative Measures and the necessity for a Veterinary Sanitary Organization. The third part deals with the special contagious maladies. It is scarcely necessary to state that every care, as well as unwearied research, have been exercised in order to render this portion of the treatise worthy of acceptance as

an exposition of modern Veterinary Science with regard to these maladies. Some diseases which exist, but have not been described in this country, and others which have not yet visited us, but may do so any day, are included; the most recent investigations of distinguished veterinary authorities have been referred to; everything pertaining to each disease has been anxiously weighed before it has been stated; and the different matters relating to it have been placed under convenient heads and in separate paragraphs (as "symptoms," "pathological anatomy," "contagion," "infection," "incubation," etc.); while the sanitary measures have received the greatest consideration. The curative treatment has also been alluded to, and the advisability of using the flesh and milk of certain diseased animals is discussed in this part, which forms, perhaps, the most important contribution to comparative pathology yet offered in this country.

The fourth division includes the inspection of slaughter-houses, meat, milk, and horse slaughter-houses—a subject hitherto utterly neglected, so far as Veterinary Science in this country is concerned.

The great and rapidly-increasing importance of the subject of Veterinary Sanitary Science, and its intimate connection with public hygiène and the general welfare of the community, must sooner or later be acknow-

ledged by those who are at present indifferent to the position or the progress of veterinary medicine in this country; and one of the chief objects of the present work is to hasten this recognition. If I only partially succeed in this, I shall not consider my somewhat arduous task to have been without reward.

All the contagious diseases to which the domesticated animals are liable have not been included in the third part of the work; two or three whose contagious character is doubtful, or which are of little moment in a sanitary point of view, have been omitted. The most important maladies, as "cattle-plague," "foot-and-mouth disease," "pleuro-pneumonia," "glanders and farcy," "variola," "rabies," "anthrax," "scabies," "tuberculosis," etc., have been almost exhaustively treated. The references in a work like the present must, as a matter of course, be extensive: the experience of one individual being of comparatively little value in such a wide subject. Many of these are acknowledged in the body of the volume, but special mention must be made of Haubner's excellent "Handbuch der Veterinär-Polizei" (Dresden, 1869), Adam's "Veterinär-Polizei" (Munich, 1862), Reynal's "Traité de la Police Sanitaire" (Paris, 1873), Röll's "Lehrbuch der Pathologie und Therapie der Hausthiere" (Vienna, 1860), and Delafond's "Pathologie Vétérinaire" and

"Police Sanitaire." The classical "Nouveau Dictionnaire Pratique de Médecine, etc., Vétérinaires," and the early volumes of Zundel's masterly re-edition of D'Arboval's "Dictionnaire de Médecine, etc., Vétérinaires," must be included in this acknowledgment.

As the work has been begun and completed without assistance, I assume the entire responsibility for the errors and deficiencies which may exist in it.

GEORGE FLEMING.

Brompton Barracks, Chatham,
December 28th, 1874.

INTRODUCTION.

SANITARY SCIENCE, in its most elementary form, and in the aspect in which we now view it, would appear to be almost as old as the advent of contagious diseases, or the discovery of the more apparent causes which militate against health and efficiency. We obtain glimpses of its existence in the writings of historians, poets, agriculturists, legislators, theologians, and medical authorities in the earliest ages; and this is not to be wondered at, for, included in public hygiène, it was frequently only a code of health in a religious form. But its benefits were not at all limited to the human species. From the time of Moses, and probably even before his era, all the great law-givers of antiquity prescribed hygiènic measures for animals as well as people: no doubt from the fact that diseases in both were common, and that pestilence among the former was so frequently death or distress to the latter. True, in the Middle Ages, we find few traces of sanitary precautions against the desolating plagues that swept away nearly the entire herds and flocks of the countries they visited. Superstitious practices were generally resorted to for their prevention or suppression; and impotent prayers, processions, pilgrimages, incantations, charms, and absurd rites were all that could be made available in presence of these inflictions. Though we may, now and again, come upon ordinances directed against the sale of flesh from unsound animals, because it was observed to induce disease in man; yet it may be said that there was really nothing which might justly be designated Veterinary Sanitary Science until the commencement of the sixteenth century, when Fracastoro,* in

* Tract. de Contagiosis Morbis.

1514, drew attention to the existence of an infecting element in certain maladies, and pointed out the advantages of isolation; thus laying the foundation of our modern Sanitary Police measures. From this time, progress has been made more or less rapidly, as a knowledge of the nature of contagious diseases and their mode of propagation became better understood, and communities appreciated the value of applying this knowledge. In the eighteenth century, veterinary medicine received a great impulse by the establishment of schools in France, and at a later period in other countries; but before this event, a most serious outbreak of that deadly scourge, the Cattle-plague, had demonstrated the immense importance of preventive and suppresive measures in dealing with these inflictions. In 1709, this bovine malady appeared in its accustomed home, and travelling westward, in 1711 it had invaded the principal countries of Europe, causing terrible losses in its progress. The State of Carniola escaped it through prohibiting, by public edicts, the admission of cattle and other animals; but Italy, through its traffic with Dalmatia, was soon invaded, and the herds of that country suffered most severely. The disease was carefully observed by Lancisi and Ramazzini, two most distinguished physicians, who have left us an excellent description of it. The former witnessed its effects among the cattle of the Romagna, and after tracing its introduction and mode of extension, and insisting on its extreme contagiousness, mortality, and incurability, he, before an assembly of Cardinals, "advised that all the diseased animals should be killed; for I maintained that, should they be left to a slow death, the cost for medicines, veterinary surgeons, attendants, and other things would be very great; and not only this, but the very contact of these men would aid in the diffusion of the contagion." Though his recommendations were only partially adopted by the Papal Government, it was not long before the malady was extinguished in that locality: the edicts issued by the Sacred College being most scrupulously enforced.*

* The history of this interesting outbreak will be found in "Animal Plagues" (p. 198).

In 1714, the same disease was imported into England, where it was localized in and around London. Information must have reached the authorities of its prevalence on the Continent, for they immediately appointed Dr. Bates, physician to George I., to investigate its contagiousness and suggest means for its suppression. By slaughtering the infected and suspected animals, disinfection, and other wise measures, the malady was stifled with such promptitude as to elicit the admiration of those countries in which it had been prevailing for some years. This was, in reality, the first occasion on which administrative measures had been adopted for the prevention of contagious animal diseases in England—for though an old ordinance had been in existence with regard to "Mange" in horses, since the reign of Henry VIII., yet it may have been a dead letter, so far as its application was concerned. In France, the first public *arrêt* with respect to these maladies is dated April 10, 1714; but that country soon perfected a code of Veterinary Sanitary Police, which was remarkably complete, and, with the additions made from time to time, has proved of the grandest service. Under the great minister, Bertin, the excellent National Veterinary Schools were founded for the promotion of Veterinary Science; and Turgot, his successor, seeing the ravages inflicted by the Cattle-plague in 1774, instituted a commission of medical men to investigate the spreading diseases of animals and mankind. This commission ultimately became the "Société Royal de Chirurgie." In some other countries similar efforts were made; but in England, in 1745, when the bovine scourge again appeared, the lesson inculcated by Lancisi and applied by Bates appears to have been entirely ignored, as it was again in 1865, and the disease prevailed for several years.

In all the principal European countries, there exist more or less efficient sanitary organizations which have for their sole or partial object the prevention and suppression of epizoötic and contagious diseases among the domesticated animals. In France, which appears to have taken the lead in this direction, the *Conseil d'Hygiène et de Salubrité* of the Seine was constituted in 1802; and since that time nearly all the large towns in that country have followed the example of Paris, in

instituting permanent commissions of salubrity. As Reynal has observed, amongst their principal functions, these councils include the study of epizoöties and virulent diseases, the inspection of fairs and markets, knackers' establishments and stable infirmaries, conduct inquiries relative to public hygiène, &c.

In this country, up to the invasion of the Cattle-plague in 1865, it may justly be said that Veterinary Sanitary Science, except in the army, had no existence, so far as the prevention of contagious diseases is concerned. Though, since 1839, grave losses were annually sustained from the unchecked prevalence of two exotic maladies—a loss probably amounting to many hundreds of thousands of pounds in some years—yet no measures were adopted, no organization devised, to remedy this serious state of affairs. It was only when the Plague was introduced in 1865, and our entire stock of native cattle was threatened to be swept off by that terrible malady, that the attention of legislators was forcibly directed to the danger incurred through our culpable negligence; and after the country had suffered a pecuniary loss of probably eight millions of pounds, and grave inconvenience and embarrassment during the two years that elapsed before it could be extinguished—through the absence of any kind of organization—we had the existing Veterinary Department of the Privy Council instituted.*

Up to 1869, for the thirty years that had elapsed since the introduction of the two contagious maladies—Foot-and-mouth disease and bovine Pleuro-pneumonia—it was estimated that the loss from these alone amounted to 5,549,780 head of cattle, roughly valued at £83,616,854. This is, of course, irrespective of the losses from Cattle-plague. There cannot be a

* It would be more than unjust to omit the mention of Professor John Gamgee's name in connection with this subject. For several years previous to 1865, he lost no opportunity of drawing attention to the culpable negligence which exposed Britain to the very serious losses inflicted by preventable diseases among animals, and predicted the invasion of Cattle-plague which occurred in that year. This veterinarian at least deserves the honour of being designated the "pioneer" of Veterinary Sanitary Science in this country.

doubt that the same rate of loss has continued, if it has not largely increased, since that period. In 1872, for instance, from one malady only—Foot-and-mouth disease—it was calculated that the money loss in Britain must have amounted to £13,000,000; but some authorities are of opinion that this is even under-estimated. In Ireland, for the same year, 220,570 cattle were reported by the police as affected with the disease; but this is undoubtedly only a tithe of the actual number, as a declaration of its existence is the exception, not the rule. Nevertheless, if we estimate the loss on each animal reported at £2 (though it may be nearer £4), we have £441,140 to be added to the above sum as the pecuniary loss incurred in the three kingdoms from the existence of one preventable malady only. The damage inflicted by contagious Pleuro-pneumonia is probably not much less, as it is always prevalent; whereas the other is more diffused at some seasons than others.

From this it will be seen that the prevalence of contagious diseases has not diminished since the Veterinary Department of the Privy Council was inaugurated, and it could not reasonably be expected that it would be otherwise. There is no efficient organization to carry the legislative measures into effect—there is no central authority to impose an uniform action upon the local authorities; and these again have no competent instruments to carry out their orders. In 1873, of the 1678 inspectors appointed by the local authorities in Great Britain, only 22 per cent. were members of the veterinary profession; 59 per cent. being members of the police force, and the remaining 19 per cent. anything. And even the veterinary inspectors are also in private practice—a circumstance which very materially detracts from their usefulness in their public capacity.

With such a mal-organization, it need not be wondered at that contagious diseases are as common and destructive as before the creation of the Department, and that the traffic in, and movement of, infected animals is scarcely checked. The action of the local authorities is irregular and disjointed; so that in one district we may have severe measures imposed, and in the adjoining one no measures at all enforced. Harassing, vexatious, and extremely expensive—comparatively—such an

organization can never be anything but impotent to protect the public from the ravages and losses inflicted by these diseases. To give only two illustrations of this : an order has been issued that cattle affected with contagious Pleuro-pneumonia are to be slaughtered. For want of a proper sanitary service, it is probable that not one animal in every twenty or more of those which are diseased will be destroyed : the others being sent to fairs and markets, or otherwise clandestinely disposed of, to spare the proprietor the trouble and annoyance of having his stock suspected and isolated, for perhaps an indefinite period. In this way is the disease maintained and spread. Not only this, but owing to the measure not being in force in Ireland, where the malady always prevails, and whence Britain has received fresh importations with nearly every ship-load of cattle for more than thirty years, it is obvious that compulsory slaughter, if carried out in the most energetic and efficient manner, must be futile and annoying when the contagion is being continually introduced. We may be told that the disease is not so prevalent in Ireland as in England ; and for this reason the severe measure need not be adopted. But those who make this statement probably forget that Ireland exports to England—not England to Ireland—and it is, in all likelihood, for this reason that the former country suffers so severely, and the latter is less scourged : as it can get rid of its diseased stock by exportation.

It is the same with regard to Glanders in the horse, which has for some years been very prevalent. Though measures have been devised to suppress it, yet from their being imperfect, but, most of all, through there being no sanitary organization to carry them into effect, it continues unchecked.

It may with truth be said that we have no statistics of disease among animals, and yet the value of these would be immense ; indeed, statistics must be looked upon as the mainspring of all sanitary knowledge. But we have, at present, no means of obtaining them.

The value of Veterinary Science has scarcely been recognized in England ; while the services it could render to Agriculture and Sanitary Science are, it is to be feared, almost wholly

ignored. And yet these services are of great importance ; for the domesticated animals constitute one of the principal elements of the public wealth, and play a very essential part in the affairs of mankind—constituting, as they do, one of the primary requirements of agriculture. Their production is an economical question of the highest order, and is becoming every day more and more urgent : being closely related to the progress of agriculture, commerce, and industry ; and considered from a social science point of view, they are the principal source of the well-being of nations.

To multiply, improve, and preserve the domesticated animals, is to render the soil more fertile, to facilitate traffic and intercourse, to augment the food resources of the country, increase the national prosperity, and promote civilization.

To all this, Veterinary Science should largely contribute. The universal belief entertained in this country, that it has only for its object the *cure* of disease in animals, is founded on ignorance of its capabilities, and is probably due to the fact that up to a very recent period it was only studied with that view. No doubt this is an important object, and one well worthy of attention ; but it is only one of many pertaining to this science, and certainly not the chief. For this science comprises within its domain all matters relating to the production and preservation of the valuable creatures man has domesticated, and more especially the causes which predispose to, or excite the development of, disease, with a view to its prevention or suppression. The contagious and epizoötic maladies are those which more particularly come under its cognizance ; as many of them are most destructive and harassing, and prove cruel inflictions to the countries they visit, or in which they are domiciled. Not only this, but the diseases transmissible from animals to the human species are numerous, and some of them most terrible and fatal—we need but mention Glanders, Rabies, Anthrax, and the most recent addition to the dread list—Tuberculosis ; there are also a number of dangerous parasitical affections with which man is afflicted through his relations with the creatures he utilizes in so many different ways.

The study of these diseases, therefore, in a sanitary point of view, interests, more or less, the sanitarian, legislator, magistrate, veterinary surgeon, and student of medicine, as well as the public at large.

Veterinary Sanitary Science, then, in taking within its scope the epizoötic and contagious diseases of animals, has to carefully study the first causes of these scourges, their origin, nature, and mode of propagation, the characters which distinguish them from each other, and from analogous affections of a less serious kind, their transmissibility, and the varying characters they offer when so transmitted—in fact, everything pertaining to them ; but more especially must it consider the administrative measures necessary to suppress them, and prevent their recurrence. It must likewise take into account the influence these maladies may exercise upon the health and welfare of human beings.

Considered in this manner, it comprises two distinct divisions : one, *medical,* which deals more especially with the etiology, mode of development, and propagation of these diseases ; and another, purely *administrative,* which includes the legislative and sanitary measures applicable to these maladies.

As Reynal justly remarks, the "medical" section is undoubtedly the most important, and demands the most extensive and complete information—information which is ever on the increase with the progress of science. It has for its object the study of the infective or contagious principles of these diseases, under the double aspect of their origin and mode of transmission from the sick to healthy creatures of the same or different species. None of the branches of veterinary medicine can be omitted in this inquiry. Pathology, and particularly etiology, are of the greatest utility ; as Sanitary Science relies entirely upon the indications furnished by them. It has not, properly speaking, a fundamental doctrine, nor a dogmatic aim ; it cannot be separated from the advance of veterinary medicine in general, and must always be subordinate to it.

The " legislative " or "administrative" portion, is chiefly

occupied with the application and perfecting of the sanitary regulations prescribed by the laws relative to the above-mentioned diseases, and might be designated the "sanitary system;" it has for its object to prevent the development or hinder the extension of these maladies. Judiciously-framed sanitary regulations, while affording security, should embarrass commerce as little as possible. Regulations, based on insufficient data, dictated by imperfect knowledge of the diseases to be prevented or suppressed, or badly carried into effect, are useless and vexatious, and bring Sanitary Science most unjustly into disrepute.

The necessity for recognizing the existence and utility of Veterinary Sanitary Science was never greater than at the present day; as the need for multiplying and perfecting the most useful of the domesticated animals, and preserving them from disease, was never so urgent. Britain, like Germany, France, and some other highly civilized countries, cannot produce them in sufficient numbers for the wants of the population. The closer international relations which railways and steamships have created, and are yearly creating, the increasing facilities for transport of every kind, and the new openings which free trade has afforded for the importation of foreign animals, have altogether changed, within the memory of the present generation even, the sanitary conditions of many countries in this respect.

In previous ages, the great outbreaks of contagious maladies among animals only occurred at rare intervals, in regions remote from their birthplace; and then they generally owed their extension to the events of war: as is evidenced by the history of Cattle-plague (even so recently as the late Franco-German war), the eruptive fever popularly known as "Foot-and-mouth disease," the contagious Pleuro-pneumonia of bovine animals, and other maladies.

Nowadays, this extension of disease is greatly modified. The movement of large numbers of animals, and their rapid transport from one country to another—often most distant; their concentration in markets; their incessant renewal; the mixing of home with foreign stock; the general indifference

of owners, statesmen, sanitarians, and the public ; the absence of anything like an organization to regulate and control this movement, carry out sanitary regulations, and investigate and check contagious diseases ;—all these have operated in producing the extension and prevalence of serious maladies. Thus it is that some contagions have become disseminated in every part of the globe within a few years—contagious Pleuro-pneumonia, for example : a malady now as great an infliction in Australia, New Zealand, America, and South and Central Africa, as it is in this country and on the Continent of Europe. It is almost the same with "Foot-and-mouth," and other diseases ; and in their dissemination, Britain must be credited with a very large share of blame : as through her laxity these maladies have not only become almost naturalized at home, but they have been allowed to spread to her colonies and other parts of the world, through unpardonable neglect of the simplest sanitary precautions.

These diseases are, for the above reasons, more or less rapidly and continuously spreading : occasioning each year the most serious losses, which go on increasing with their extension, and the higher value animals are everywhere attaining. Hygiène is as impotent to prevent the encroachments of the most serious of these scourges, as therapeutic devices are to cure them. Therefore, only the employment of sanitary measures, founded on a careful study of them, can preserve communities from their destructive effects ; and while it is the object of the producers of these animals to multiply and bring them to as great a state of perfection as possible, it is no less the duty of Veterinary Sanitary Science to aid in this perfecting, and to indicate in what way they may be best and most economically maintained in health and protected from the ravages of disease. Legislators, medical authorities, and the general public should render every assistance in this direction, as the subject is really of the highest national importance.

Veterinary Sanitary Science should also take cognizance of other matters, more or less related to the domesticated animals, and the health of the human species. Among these should be included the inspection of animals destined for

food, both before and after slaughter, in order to ascertain the fitness of their flesh for consumption. Veterinary surgeons should be the most competent for this duty. And so with animals yielding milk ; even the inspection of that most essential fluid should be entrusted only to the well and specially-trained veterinary inspector, as it is a matter of great moment, if only from the revelations recently made with regard to the transmissibility of Tuberculosis by the ingestion of the flesh and milk of affected animals. The inspection of public abbatoirs, private slaughter-houses, knackers' establishments, fairs and markets, and other places where animals are congregated, is another very important duty pertaining to this science, and which can alone be efficiently discharged by veterinary surgeons, because of their special studies.

Veterinary Sanitary Science, then, is only a branch of what may aptly be designated "State Medicine ;" and the administration, on which devolves the care of watching over and protecting the public health and fortune, incurs a great responsibility in ignoring it ; for this duty cannot be satisfactorily accomplished unless the Government is enlightened by Sanitary Science, and has the concurrence of men whose special knowledge renders them alone capable of assisting in solving the various problems, sometimes so difficult, pertaining to public hygiène. True, the public mind requires educating in this matter, and until it is so educated the most glaring evils will be tolerated at almost any amount of sacrifice ; but advancement will most certainly take place if statesmen can only be led to appreciate the immense importance of the subject, and the great interests there are at stake. In no country in the world, perhaps, is this subject so urgent as in our own ; and in no country, perhaps, has it been less recognized.

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ERRATA.—(Vol. I.)

Page 49, line 34, p. 50, lines 17 and 20, for "micrcocus" read "micrococcus."
,, 55, ,, 12, for "could have done less" read "could do less."
,, 59, ,, 3 in foot-note, for "father" read "rather."
,, 146, ,, 7 in foot-note, for "has" read "had."
,, 149, ,, 10 in foot-note, for "from" read "form."
,, 152, ,, 2, for "have" read "has."
,, 179, ,, 21, for "and a temperature" read "or a temperature."
,, 190, ,, 5 in foot-note, for "more" read "none."
,, 322. ,, 18, for "to" read "on."

A MANUAL OF VETERINARY SANITARY SCIENCE.

THE NATURE OF GENERAL ANIMAL DISEASES.

HEALTH AND DISEASE.

We may look upon an animal, taken apart from its fellows, and viewed with regard to the beautiful and wonderful designs of creation, as an organic entity: an astonishingly complex living machine endowed with certain attributes, and whose existence is dependent upon the performance of various functions which are allotted to particular organs composed of suitable materials.

When these organs are intact, and capable of discharging their respective duties; when the functions upon which the life of the individual depends are in perfect and harmonious action; and when the laws which regulate them, and adapt them to the influences of the external world, are in full force—then we say that this creature is in a good state of health.

But when this collection of organs which enter into the composition of a living being, and which has consequently been designated an "organism," is submitted to certain influences or conditions which hinder or pervert some or all of its component functions, a number of phenomena are manifested to which we apply the term "disease."

Disease, then, however produced, is not a something alien to the organism, a positive factor which has entered the body, and must, if health is to be restored, be expelled, because it is foreign to it; but is, in the wide sense of the term, only the expression of a diminution or disturbance of the vital power inseparable from life itself: an unequal balancing of the

organic functions, tending to abstract from life that which is necessary for its proper maintenance.

This apparent derangement is developed in accordance with certain laws, and in connection with a particular condition which the body has wholly or partially assumed.

SPORADIC DISEASES.

When an individual, or isolated individuals here and there, is attacked—if we may use the expression—by disease which may be due to occasional determining causes, or to the predisposing peculiarities of the individuals, the term sporadic (from *σπειρω*, to sow here and there) is given to the malady.

But as species is only another name for a collection of individuals possessing special features of a uniform character, so far as regards their vital and physical endowments, we sometimes find it to be an advantage, in the study of disease, to look upon a species as we would upon a single individual when the whole, or a portion of the whole, are affected with derangement of one or more functions.

ENZOÖTIC AND EPIZOÖTIC DISEASES.

The diseases of a mass of living beings belonging to a species lower in the scale of creation than man—diseases indicated by organic and functional disturbance, are said to be enzoötic (from *ἐν*, in, and *ζῶον*, an animal), or epizoötic (from *ἐπὶ*, on, and *ζῶον*, an animal); designations which have their equivalent in the terms endemic and epidemic, applied to similar maladies in mankind.

So far as the diseases themselves may be concerned, these terms are synonymous; but so far as their causes can be appreciated, and their permanent or transient operation on the creatures becomes marked, the designations "epizoötic" and "enzoötic" must be considered as distinct.

Thus, when a certain disease reigns over a wide extent of country, though only for a limited period, it is said to be epizoötic in its character; but when its ravages are more permanent and circumscribed, and its phenomena seldom, if ever, absent from a particular region or locality, and more or less

dependent on circumstances connected with that locality, then it is pronounced to be enzoötic.

NATURE OF EPIZOÖTIC DISEASES.

Epizoötic diseases may be *contagious* or *non-contagious;* and some, indeed, may appear to be contagious at one time and not at another; or their contagiousness may be doubtful to some observers and not so to others. The distinction, though marked in some maladies, less so in others, is most important with regard to sanitary measures. The contagious epizooty may be enzoötic in a certain region, and only become epizoötic by the diffusion of its virulent principle. Generally, it appears in a locality into which it has been introduced, and spreads thence, as from a centre, its successive steps being more or less easily traced; and, according to the inherent vitality of its virulent principle, it may withstand the influences of climate, temperature, &c., and extend over an immense surface of the globe, being propagated slowly or rapidly, as circumstances or the nature of the contagion permit. It is with the non-contagious epizoötic diseases that we have now particularly to deal, those which are contagious being reserved for more careful examination.

It may be noted in this place, however, that contagion or infection plays by far the largest part in the dissemination and maintenance of these general maladies, and that four kinds of infection have been recognized, all of which may be the cause of epizoötic diseases. These are *virulent infection*, *miasmatic infection*, *septic infection*, and *parasitic infection*. The first is exemplified by the Cattle-plague, specific Pleuro-pneumonia of bovines, Sheep-pox, Glanders, &c., the second by what has been termed "typhoid fever," and by anthrax and anthracoid affections generally; the third by the latter class of diseases, as well as several of those due to alterations in the quality of the food; and the fourth by Scabies and parasitic affections in general. These will be alluded to at greater length in the third section of the work.

Epizoötic diseases, then, form that class of disorders which is known to affect many animals of one, or even different,

species, over a more or less extensive area, at or about the same time, irrespective of these diseases being due to the presence of a miasmatic or infecting agent, or to the influence of transient causes. Some authorities are of opinion that we ought to apply the term to an *accidental* morbific cause, which suddenly produces disease in a great number of animals of the same or various kinds, and which ceases to act after a more or less prolonged period of time, and after producing its effects in many localities by one or by repeated attacks.

The term, from its etymology, should be employed to indicate all acute, or even chronic, affections which appear in this diffused manner; and regarded in this sense, nearly all the maladies to which animals are liable, if attacking a large number instead of only a few isolated individuals, must be considered as epizoötic. Thus, many comparatively insignificant affections are included with those of a most serious character. For a long time, however, custom has somewhat limited the application of the term *epizoöty*, and now it is, at times only, employed to designate those general, and what might be denominated internal diseases, which are ordinarily acute in their nature; which are developed about the same time in a number of animals of one or more species, and inhabiting an unlimited space of country; which persist for a variable period; and which may be ascribed to common and general causes that have become modified in some peculiar manner.

They are, as a rule, the most formidable of all diseases, and may extend far and near, affecting and destroying the animals of many different regions; and not unfrequently they defy the skill and energy of man to suppress them, or mitigate their effects.

For this reason, from the earliest ages, they have been a source of dread and mystery, and have multitudes of times produced incalculable loss and suffering to man. Nearly every language has its word for these visitations; and our own popular terms, such as "murrain," "plague," "pestilence," are relics of the antique notions that prevailed regarding them, and significant of the awe with which they were regarded.

NATURE OF ENZOÖTIC DISEASES.

An "enzoöty" is due to a permanent, periodic, or occasional cause operating in a more or less spacious area, and peculiar to a certain region or locality. The general characteristics of enzoötic diseases may be summed up as follows:—They usually appear and disappear at certain seasons of the year, or in certain years, or prevail in a constant manner; they ordinarily attack only one species of animal; they depend upon local causes, due in some instances to the influence of the seasons, atmospherical perturbations, bad or improper food or water, septical emanations, undue labour or fatigue, the geological conformation of the district or its physical configuration; or a combination of two or more of these influences. The diseases composing this category are numerous and well-known, and among the most notable, perhaps, we may allude to anthrax in one or more of its numerous forms. The morbid influences at work in inducing them may be said to operate slowly (though there are many exceptions—even the above mentioned disease is one), the maladies not manifesting themselves suddenly, but, as it were, insensibly; and they are frequently of longer duration than epizoötic affections, assuming a chronic character. From their being oftentimes of a contagious nature, they become epizoötic in the same manner as some sporadic diseases; they then extend beyond their ordinary boundaries, and sometimes resist, to an astonishing degree, the curative measures devised to remedy their effects.

EXTENSION AND PERIODS OF EPIZOÖTIC DISEASES.

Different invasions of an epizoöty are distinguished by their degree and mode of extension; some, for instance, are developed within narrow limits, while others are spread over wide areas, without our being able to explain satisfactorily why they should be so.

During its prevalence, an epizoöty usually presents three well-marked periods, the duration of each being, however, by no means certain. In the first, the "invasion" or "commence-

ment," a few animals only may be affected, and the disease may or may not appear at different points; in the second period, the "apogee" or "crisis," of the epizoöty, it is widespread, and perhaps more intense in its character or severity than at its invasion; and the third period, or "period of decline," when fewer animals are attacked, cases of immunity are more and more frequent, and the malady assumes a milder aspect, becoming readily amenable to medical treatment, while spontaneous recoveries occur in larger proportion.

In some epizoöties—and particularly those of a contagious character—these periods are distinctly marked, but in others such a regular course cannot be observed. In those of a miasmatic nature, a storm may suppress them, or favour their extension; a change in the atmospherical temperature or constitution, may do the same, and other influences may abridge, or altogether efface their regular periods.

Some epizoötic disorders, and especially those which depend for their extension upon the presence of a contagium—like the Small-pox of man, or the Variola of sheep, or Lung-plague or Cattle-plague of bovines—commit the greatest havoc when they are first introduced into a country, often attacking and sweeping off all who become contaminated—and these are always in large proportion; just as the North American Indians were decimated by entire nations when the variolous disease was first carried among them through the agency of the white man; and as our cattle were destroyed by the cattle-plague in 1865-66, by the Lung-plague in 1841, and the Foot-and-mouth disease in 1839-40.

PANZOÖTIC DISEASES.

The term *panzoötic* (from πᾶς, all, and ζῶον, animal) is sometimes employed to designate maladies which attack all, or nearly all, the animals of different species over a large surface of country; such as the so-called "foot-and-mouth disease," "rabies," "anthrax," &c.

These distinctions, however, do not always hold good, as we all frequently have occasion to observe. Circumscribed by

geographical boundaries, the causes of an enzoötic disease may act as preparatory agents, by modifying the constitution, and giving rise to a special predisposition; which again is transformed into a morbid state when particular circumstances, such as unfavourable weather, famine, &c., lend their aid.

MEDICAL CONSTITUTION.

There is a peculiar influence affecting the animal constitution, with the effects of which veterinary surgeons are well acquainted, especially during the prevalence of sporadic or enzoötic, and even epizoötic, diseases, and sometimes at particular seasons of certain years; though having no connection with the ordinary influences of these seasons.

This influence, or *divinum quid*, of which we know little, if anything, except in its effects, seems to modify the vital functions, and to diminish their integrity to such a degree as to impress a particular physiognomy on existing diseases, independent of their nature or seat. Maladies which generally assume an intense inflammatory character, and require active treatment before they can be subdued, during the reign of this *medical* or *morbid constitution*, as it has been named, take on a typhoid condition, which necessitates the very opposite management, and must be met with careful nursing, and the exhibition of stimulants, if they are to be successfully combated. Wounds are disposed to become unhealthy and gangrenous, and ordinary surgical operations, such as castration —no matter how skilfully they may be performed and subsequently attended to—are likely to be followed by serious consequences.

The prevailing "morbid" or "medical constitution" influences, in fact, the predominance of certain characters in the types of disease, induces certain organs to become involved, or favours the appearance of particular symptoms, and determines the benignant or malignant course of maladies.

Through this and other influences, which will be alluded to presently, when animals have suffered any degree of modification in their constitution, whereby their power to resist morbific agents is diminished, we know that, according to

physiological and pathological laws, they are liable to be attacked by disease should they be exposed to any exciting cause.

ENZOÖTIC AND EPIZOÖTIC MORBID CONSTITUTIONS.

This medical constitution of the atmosphere—for as yet we cannot assign it any other location—when manifesting itself in a limited area, might be named the *enzoötic morbid constitution;* but when it prevails widely, and exhibits its influence among a great number of animals of the same or of different species, endowing their maladies with one common and prominent character, it might be designated the *epizoötic constitution.*

If it prevails for a somewhat long period, and acts in the same manner by impressing a common character on the diseases which may arise during its reign, it is qualified as *stationary;* but if it changes with the seasons, it is termed the *constitution of the year.* Since the earliest times, different medical constitutions have been noted and classified. For instance, there is an *inflammatory constitution,* in which is remarked a predominance of violent inflammations, particularly of the lungs, and which are most successfully treated by energetic antiphlogistic measures; a *rheumatismal constitution,* marked by a tendency to inflammation of serous and fibrous membranes, especially after sudden changes of temperature; a *catarrhal constitution,* in which the mucous membranes of the head are chiefly involved; a *gastric constitution,* with a predominance of gastro-intestinal catarrhs; a *bilious constitution,* in which acute or subacute diseases of the liver, dysentery, and intestinal catarrhs are observed; a *nervous constitution,* manifested by debility, lassitude, and the prompt appearance of symptoms of nervous disturbance complicating every disease; and a *septic constitution,* evidenced by a tendency to profuse hæmorrhage, low fever, and rapid sinking of the vital powers.

We know no more of this "epizoötic constitution" than of that termed the "medical constitution;" indeed, they would seem to differ only in intensity and general prevalence, and they must not be confounded with other causes or influences

which belong to atmospherical conditions, and which are much more easily appreciated.

INFLUENCE OF THE EPIZOÖTIC CONSTITUTION.

The power of this epizoötic constitution or *genius*, as it has been named at times, is not unfrequently marked in an extensive and unmistakable manner on nearly all living creatures at the same time, man being influenced by it as well as the lower animals. In the history of epidemic or epizoötic diseases, we have many illustrations of this fact. A very notable one was observed in the interval between the years 1829 to 1832, the period when Cholera visited Europe so severely. Mankind was chiefly visited, but the domestic and even the untamed animals, including birds and fishes, suffered from the choleraic influence. The "Black Death" of the fourteenth century furnishes another illustration; and during the epidemy of *la grippe*, or "influenza," which appeared in France in 1831. 1832, and 1837, many kinds of animals, and notably the horse, were equally affected.*

Though these general manifestations of the epizoötic constitution are by no means unfrequent, yet it is more common to see mankind affected by various epidemic diseases, and the lower animals remain healthy; or the latter suffering, perhaps most severely, from epizoötic visitations, while the human species is unaffected. Even some of the different species of domesticated animals will enjoy immunity during the prevalence of a general disease which is ravaging others; perhaps only one species may be suffering. A peculiar epizoötic constitution is said to prevail when anthrax breaks out in a severe or unusual form, or when the paralytic Vitulary fever of cattle and goats appears extensively, and beyond the evidence of its occasional causes.

As certain animals, from their temperament, their organization, the nature of the country they inhabit, or in which they

* Numerous examples of this epidemic or epizoötic constitution will be found in the history of these general maladies from B.C. 1490 to A.D. 1800, described in my work on "Animal Plagues" (Chapman and Hall, London).

have been reared, the food they receive, the labour to which they are submitted, and other hygienic circumstances, are rendered more or less apt to resent the operation of causes which give rise to disease; so also certain states or conditions of the organism may favour, diminish, or render null, the general influence of the epizoötic constitution. The seasons, variations in the constitution of the atmosphere, and other circumstances, may also modify the peculiar state. But those medical and epizoötic constitutions, to which geographical situation, atmospherical changes, seasons, climates, or races of animals of the same species, can make no great difference either in the progress or the symptoms of maladies, and which exert but a feeble influence in most cases on their malignity, are, we must remember, in the majority of instances, due more to contagion than to any other cause.

The veterinary practitioner has every reason to bear in mind, in his treatment of disease, that the medical and epizoötic constitutions not unusually produce such alterations in the system of animals affected, that, as has been already remarked, very different therapeutical measures must be adopted. It is well known, for instance, that often during the prevalence of "influenza," other diseases exhibit a very unusual degree of intractability and danger, and sometimes assume an altogether special character.

An unfavourable state of health in animals, then, whether due to general or local causes, lays them open to the attacks of disease, no matter whether it be indigenous or exotic. The Cattle-plague appearing in cattle only after they have left the Steppes of Southern Russia, where they were apparently in excellent health, might by some be taken to prove that the external agent in the production of the disease, notwithstanding its permanence, only determines the malady after the constitution has become modified by fatigue and hardship; and that, under the sway of a parallel condition of the organism, every accidental morbific agent enjoys the privilege of producing or developing the specific affection.

It may be that in this way a malady can be imported and become epizoötic in a country where, perhaps, at other times the

predisposition to its reception not existing, or being but feebly present, the generating poison would be nearly or quite inert.

But when the collective organisms, as we may term a large number of animals, have experienced preparatory modifications which favour the advent of epizoötic diseases, any accidental cause may easily develop the germ of the malady, should its origin not depend exclusively on the presence of a virulent element. The predisposition is then essentially transitory, and lasts no longer than until the epizoötic influence has ceased to act.

The conditions on which the existence of this class of diseases depends are scarcely a permanent attribute of their geographical boundaries. Breaking from their birth-place, they march in company with their cause, becoming the more widespread as the latter is extended.

DISTINCTION BETWEEN ENZOÖTIC AND EPIZOÖTIC DISEASES.

It must be remembered—and it has been already hinted—that the line of demarcation between an epizoötic and an enzoötic disease is not always well defined, nor is it absolute. On the contrary, epizoötic diseases are often observed which have a very circumscribed domain; while enzoötic maladies are found occupying a most extensive region, and escaping from their home under favourable circumstances, they may assume the character of an epizoöty. Some epizoöties are at first limited in their scope, and confined to a very small space, depending on local transitory causes for their existence. When these causes are not removed, then the diseases may become enzoötic. Such were the outbreaks of Glanders and Farcy which used to play sach havoc amongst the horses in this country during the *régime* of the old-fashioned, badly-ventilated, crowded, and filthy stables, when bleeding was the remedy for every real or imaginary disease, and was often even resorted to as a prophylactic measure. And Anthrax—a disease markedly enzoötic in different parts of the continent of Europe, in many parts of the world, and in this country—

has, on numerous occasions, assumed an epizoötic tendency, invading regions where it was not usually known. Some of these irruptions were very remarkable, and possess the greatest interest for the epizoötiologist. We need only instance those of glossanthrax in 1682 and 1731-2.*

When, as has been said, an enzoötic disease elaborates a virulent element, through the medium of which it is propagated, we can no longer distinguish it from an epizoöty. Thus Cattle-plague, however it may originate in its native regions, when it appears beyond the limits of these, is the exclusive product of contagion. And so with some other serious maladies of animals. The contagious Pleuro-pneumonia of cattle was, two centuries ago, an enzoötic disease limited to a very small area of Central Europe. It is now known on every continent of the globe, having reached so far as Australia and New Zealand, extended its ravages to America and Southern Africa, and penetrated to Asia Minor.

Epizoötic diseases, again, may become enzoötic in some of the countries which they visit. We have good illustrations of this in those which have been imported into this country. Through its nature not having been recognized when it first appeared, and owing to the neglect of all sanitary precautions when its contagious and destructive character became at last known, the above-mentioned Lung-disease of cattle has, it might well be said, become native to our pastures and cow-sheds, and will demand great exertion and heavy sacrifices, and cause a large amount of inconvenience, before it can be extinguished.

A very curious and remarkable example is to be found in the disease of the male and female generative organs of the horse, known as the "Coition, or chancrous disease" *(Maladie du coit, Chankerkrankheit).* This affection, appearing at first as an epizoöty in the Russian studs, has travelled as such through many provinces of Eastern Prussia, Austria, and France, and is now well known in Algeria. In all these countries it has assumed an enzoötic character.

* See for these and other examples, "Animal Plagues."

DIVISIONS OF EPIZOÖTIC DISEASES.

The diseases of an epizoötic kind which may appear in a country, are divisible into three classes. The first class consists of affections of an ordinary sporadic kind, which, owing to peculiar circumstances, become widely disseminated. The second class includes those maladies which, indigenous to certain countries, may appear in others where they were previously unknown, being conveyed to them by infected animals, contagious media, or some other obscure means. The third class, the least frequent, is made up of diseases that break out in countries now and again, and are quite of a novel kind, having no antecedents, nor any exact analogue in these or other regions.

The maladies of the second and third orders may have a reign of longer or short duration, and then disappear, to be seen no more for a long time; or they may domicile themselves in their new territory—become naturalized, in fact—and then be a source of permanent loss.

Ordinary sporadic affections which take on an epizoötic diffusion, often no longer preserve their original characteristics. Though the seat of the malady may not be changed, yet only too frequently there appear complications which greatly increase the gravity and mortality attending it.

In sporadic cases of disease, it is nearly always possible to remove the individuals from the continued causes which provoke the attack, or at least to diminish the power of these causes; but ordinarily the morbid agent, after having done its work, disappears, though its effects persist. In epizoötic diseases, on the contrary, the animals remain under the influence of the agents which have disordered their healthy functions, and the causes do not cease to operate during the whole course of the disease they occasion. It is for these reasons that it has been surmised that a heterogeneous element is present in the animal economy, and to its existence there has been attributed the complications and disastrous results attending this class of maladies; and it may be the

influence of this element which impresses that peculiar physiognomy observed in intercurrent affections at certain times.

PECULIARITIES OF EPIZOÖTIC DISEASES.

A remarkable feature of some epizoötic diseases, be they due to simple or contagious miasmata, is to be found in the circumstance that one attack, as a rule, renders the organism refractory to the subsequent influence of the cause, and thus insures the animal against another seizure—if not for life, at any rate while the diseases are prevalent; secondary attacks being quite exceptional. Examples of this are to be noted in Cattle-plague, contagious Pleuro-pneumonia, and the different forms of Variola. On the other hand, there are some which do not confer this immunity; secondary, and even repeated attacks being by no means rare. A good illustration of this is to be witnessed in the so-called "foot-and-mouth disease" of ruminants, the peculiar pyogenetic fever of solipeds, vulgarly termed "strangles," the protean disease, "influenza," and the "distemper" of the dog.

Another peculiarity observed in epizoötic diseases, and which is not generally noted in sporadic affections, is that the latter, in their early stages at least, are tractable, and their advance to other stages may be averted by appropriate measures. Not so with the former; once developed, they are only interrupted in their course by death; or if terminated by recovery, they must have passed through all their different phases. And again, the serious character of an epizoöty does not always depend exclusively on the extent of the organic lesions discovered after death; neither does an attentive study of these lesions furnish indications which would tend to assure successful treatment of the disorder.

The inability of art to contend successfully with the majority of enzoötic and epizoötic diseases, compared with its certainty in sporadic maladies, depends entirely, it would appear, upon their *genius*, or the aggregation of unknown influences which engenders the epizoötic constitution in animals.

DIFFERENCES IN EPIZOÖTIC DISEASES.

All epizoöties are not of the same importance, nor are they alike serious in their results. There is a wide difference, for instance, between the comparatively mild invasions of "foot-and-mouth disease," and the fearfully malignant and destructive inroads of "cattle-plague."

Among them are some which commence simultaneously in a number of places scattered over a large surface of country. Others begin in a district, and from this wander progressively over an extent of territory often immense, sometimes advancing in a regular manner, and passing, with little or no alteration, through the most diverse climates; in the case of some, from east to west.

There are others which are propagated with extreme rapidity from one country to another; while others, again, move so slowly, and in such a way, that they are often many years in one region before they reach another—though during the whole of this time they are not extinct, but may be traced through all the intermediate districts. At other times, an epizoöty will completely disappear for a season, but only to re-appear with increased virulence.

DURATION OF EPIZOÖTIC DISEASES.

With regard to their duration, epizoöties present great differences. There are those which are merely ephemeral—subsiding after a few months' duration, like some of the outbreaks of influenza, which, in particular instances, have only existed for a limited number of days in particular districts; and others which linger for years in the successive countries they invade and ravage.

PHASES OF EPIZOÖTIC DISEASES.

Epizoötic diseases, especially in an acute form, pass through their phases like enzoötic or ordinary sporadic affections, having their period of invasion, crisis and decline, as already mentioned. When certain epizoöties, such as Cattle-plague, are due to contagion or infection—depend, in fact, upon a

viruliferous agent—and are left to themselves, these periods are well marked, because they are an inevitable consequence of the causes which bring them into existence. The virus, when introduced into a locality, constitutes a centre which at first extends but slowly; but as it sends out portions in all directions, the centres become multiplied, and spread indefinitely. But, in time, the propagating element becomes exhausted; either because its virulence is spent and it has lost the power of regeneration, or because the individuals which have hitherto escaped its action have not been fitted to receive it, and it then dies out. The contaminating agent of other contagious diseases, however, seems to possess an extraordinary vitality, and a strange capacity to remain in a comparatively latent state; becoming apparently extinguished, or only manifesting itself here and there at long intervals, until circumstances favour its recrudescence, when it bursts out afresh with all its malignancy and tendency to spread.

As examples we might instance scarlatina and variola in man, and contagious Pleuro-pneumonia and Cattle-plague (in its own home), as well as Variola in the sheep.

ACCESSORY CONDITIONS REQUIRED FOR THE DEVELOPMENT OF EPIZOÖTIC DISEASES.

Many epizoöties require certain accessory conditions for their existence, without which they cannot pass through their regular periods. It is well known that a sudden atmospherical change—such as happens during a storm—favours the propagation of miasma, increases the receptive powers of the organism, and may suddenly exalt to its greatest dimensions an epizoöty just commencing to spread. A diminution of temperature, the occurrence of frost, a few days' heavy rain, strong winds, or similar causes, have been sometimes supposed to arrest others. This has been more particularly observed with regard to those maladies which are originated and maintained by a miasma; contagious diseases are not generally so influenced.

SPECIAL PECULIARITIES OF EPIZOÖTIC DISEASES.

One of the most striking contrasts between a sporadic disorder and one of an epizoötic character, is the variable aspect of the latter in its phases. In almost every epizoöty, there are epochs when the animals nearly all die or all recover; no matter, it would seem, what kind of treatment may be adopted, or even if they are not treated at all. There are also periods when all the animals attacked offer symptoms which would seem to demand prompt antiphlogistic treatment; and others, again, when the vital powers are low and feeble, and require careful husbanding.

For this reason it is, that no general rules can be laid down for medical treatment, and it is often sufficient to attend rather to the particular physiognomy and phases assumed by the prevailing disease, and to conform the treatment to these, than to watch each particular case, and minister to its symptoms.

COMPARATIVE FREQUENCY OF EPIZOÖTIC DISEASES.

It cannot have failed to strike those who have made the history of animal plagues their careful study, that, compared with early times, or even with ages not so distant from our own, certain epizoöties are now much less frequent in many countries—thanks to the progress of civilization, a better appreciation of public hygiène, and an increasing knowledge of the laws on which animal health and the spread of disease depend. A review of their history, and an acquaintance with their characters, would also seem to reveal the fact that the majority of them belong more particularly to the early stages of human progress. The most dangerous maladies come to us from regions which are inhabited by people little advanced in civilization, and who are, consequently, far behind in reclaiming or improving the insalubrious tracts in which these pestilences are supposed to arise, or be maintained; their notions of hygiène are of the very crudest; and their knowledge of diseases, or the sanitary measures necessary to limit or suppress them, is obscured by superstition or ignorance.

In countries pretending to anything like modern civilization, we seldom now hear of, or witness, the terrible epidemic and epizoötic scourges which harassed the civilization of not many centuries ago ; those visitations which swept off the shepherds, and the flocks and herds they tended ; and which spread desolation throughout towns and villages, as well as stables and homesteads—almost denuding entire kingdoms of their human and animal population, and not even sparing the feathered tribes.

IMPORTANCE OF THE STUDY OF ANIMAL PLAGUES.

Though we are yet far from being able to pronounce definitively as to the nature of some of the disease-producing agents, yet we know that they must be sought for in the conditions to which we submit the life of the masses, no less than of the individual ; and that it is in the air, the earth, the water, and the aliment by which they are maintained, that the real sources of enzoötic and epizoötic diseases must be traced. Much valuable knowledge pertaining to this subject will have been gained when veterinary science has established the relations that exist between the climate, the soil, and the customs prevailing in various parts of the globe, with the physiological and pathological conditions of the various species of animals man has submitted to domestication. For we know that different countries have different diseases present in them, or diseases which, though common to all, yet vary considerably in their chief characteristics ; and we are led to believe that these differences and variations must be due, in great part at least, to those physical agencies which so much deserve investigation. Upon locality, combined with other similar influences, the type of disease, and also the constitutional race-characters of the animals, the dissimilarity in symptoms, and the rates of mortality, may greatly depend.

INFLUENCE OF CIVILIZATION ON ANIMAL PLAGUES.

As the great human family becomes multiplied, and civilization rapidly advances, the demands of life become increased

and more complicated; but intelligence, which advances with civilization, redoubles the efforts made to maintain the equilibrium between the growth of populations and the necessary supply of food. It is these demands which have brought the cultivation of the soil to such perfection; which have reclaimed lands, not only barren and useless, but positively injurious, because they were the sources of pernicious maladies—the laboratory of pestilential emanations. These demands have also perfected, and enormously increased in number, the domesticated animals so essential to mankind; and it is entirely owing to them that commerce has become so extended between countries as to greatly diminish the chances of the occurrence of those terrible famines which so frequently ushered in the plagues of man and beast.

But, on the other hand, as civilization removes, or tends to remove, the ancient generators of disease, it brings about changes which are not without drawbacks. The more artificial conditions of life which are created, and to which the domesticated animals are forced to submit, bring into play new influences, which modify their constitution in such a manner as to render them susceptible of general maladies of a new type, and of a character corresponding to the artificial causes which induced them. It is only by taking this view of the subject that we can account for the appearance of diseases which, a few centuries ago, were, so far as present accessible evidence leads us to believe, unknown. For instance, according to all written testimony, the "foot-and-mouth disease" of ruminants and swine is a comparatively modern affection; so is the so-called "venereal disease" of horses, the "typhoid fever," "cholera," or "measles" of pigs, the contagious "foot-rot" of sheep, and other maladies of a similar kind. The Variola of sheep, a most destructive disease, can be traced no farther back than the ninth or tenth century; while the contagious Pleuro-pneumonia of bovines only dates from the middle of the eighteenth century—at least we have no satisfactory proof to the contrary. Certain exanthematous affections of cattle are also quite modern, and the so-called "typhoid diseases" of the equine species have been observed only for a compara-

tively brief period. And so with other maladies of the domesticated animals.

INFLUENCE OF TRAFFIC ON ANIMAL PLAGUES.

It must not be overlooked that the facilities for averting famine and promoting intercourse which commerce and speedy communication have brought about, are not without their pains and penalties in exposing countries—continental and insular—to the introduction of maladies which are foreign to them, and which are frequently all the more serious and deadly the farther they travel from their home. For as we have just said, there are diseases of the pestilential kind peculiar to different countries, where they are maintained or generated, and which only appear in other regions as imported or exotic maladies. These belong more particularly to the contagious class, and they may be carried to countries widely separated from their own, owing to the vitality of their contagium, and become fixed in these, to the great destruction of the animals affected by them.

From this combination of circumstances is Britain ever exposed to the invasion of maladies generated in, or peculiar to, other countries where they have their congenial *habitat;* and to it is due the fact that the antipodes has been visited by scourges which a short time ago were known to exist only in a very limited portion of the European continent. Through the greatly augmented intercourse that has sprung up between nations the most distant in a geographical sense, and the rapidity with which the animals of one hemisphere may be transported to another, the diffusion of contagious diseases may be readily accomplished; and there is nothing but the intelligence of man and the *teachings of science* to interpose a barrier to their progress, or to modify or annul their effects when they appear.

PREVENTION OF ANIMAL PLAGUES.

Trade and intercourse are necessary for the welfare of the human family, and man cannot exist without the assistance of certain animals, whose multiplication and improvement con-

stitutes an essential feature of civilization. The dangers to which these animals are exposed—and through them the well-being of mankind—can only be averted by an exact comprehension of the diseases to which they are liable, an acquaintance with the various influences which operate to induce, maintain, and propagate these diseases, and the establishment of a system of sanitary police, efficiently organized, and provided with preventive measures based on this knowledge.

This subject of veterinary sanitary police is of the greatest importance to every country, and in direct proportion as the populations increase and become more dependent upon animals for labour or food. Its importance has as yet only been partially recognized by the most enlightened governments, and the losses sustained through its neglect, especially in this country, are something appalling. The fact pointed out by science, that some of the most destructive of these animal plagues can be placed completely under the control of man, appears to have been almost or entirely ignored ; consequently, no systematic attempt worthy of the name has been made to place restrictions upon the diffusion and destructiveness of scourges with whose mode of extension, at least, we were quite familiar ; the measures proposed and carried into execution have been nearly always as futile as they have been vexatious to trade and injurious to the public interests, and they have seldom been devised by a proper knowledge of the special diseases to be suppressed. But we will recur to this subject at another time, when treating of the measures for the prevention of these diseases.

CAUSES OF SPREADING DISEASES.

We have before briefly alluded to the causes of the general diseases of animals, and as the importance of this subject cannot be over-rated, because on the extent of our knowledge with regard to it depends very much our success in the prevention of these maladies, we will now enter more fully into its discussion.

The study of the numerous causes which give rise, directly or indirectly, to disease, constitutes that division of general pathology to which the term *etiology* (from αἰτια, cause, and λογος, discourse) has been applied, and for this reason it has been well named the "philosophy of medicine."

From its great importance it has always attracted universal attention, with a view to the prevention of human or animal diseases. To facilitate its study, the subject of etiology has been divided in section which allots the various causes to different classes—usually four. These are (1) the causes which *predispose* to disease; (2) those which are *occasional* or *accidental*, and induce disease after the organism has been prepared by the predisposition; (3) the *determining* or *exciting* causes which give rise to various diseases; and (4) the *specific* causes when they occasion maladies always of the same or of a similar nature.

The causes themselves have received various names, such as *factors*, *agents*, *morbific*, *morbigenous*, or *nosogenic influences*, *viruliferous elements*, &c., and they have been defined generally as modifiers of the organism, operating externally or internally, and capable, not only of inducing, hastening, or determining the development of morbid affections, but also of maintaining, prolonging, or aggravating them. Their number is so great and varied, that when we begin to investigate them it seems as if Nature herself had conspired against the health, nay the very life, of the beings she has created. There appears to be a constant warfare between her agents and the vitality

of the higher organisms, and the slightest defect in these is turned to account.

DIFFICULTIES ATTENDING THE INQUIRY INTO THE CAUSATION OF DISEASE.

By the very reason of their multiplicity, of their too often obscure character, the subtle manner in which they operate, and the hitherto insuperable difficulty of isolating many of them, the study of the agents which produce disease is as yet in its infancy. Our knowledge of histological anatomy and of physiology is still too limited for us even to determine in what their morbid acts consist, or in what way they may modify the vital functions, and thus produce that disordered state of one or more of them which we designate disease.

For of all the profound and mysterious objects which surround us, the animal body in its higher development is that which seems the very essence of mystery and complexity. The most minute and exquisitely elaborate organization is wedded to, and dependent upon, chemical affinities of an apparently inscrutable character. A wonderful agency—the nervous system—governs, while it is sustained by, intricate and obscure processes ; and yet we cannot tell the nature nor explain the laws which control its actions. All that is wonderful, beautiful, and grand in creation appears to be concentrated in the higher forms of life, but in the closest alliance with obscurity, inexplicableness, and perplexity to the inquirer.

Diseases, the most prevalent and familiar to us, are yet hidden in their origin, and evidently in vain we exercise our skill in interrogating the earth, air, and waters, or the chemical and physical agencies which are everywhere in operation around us. Some of the causes may be so subtle, and yet so evanescent, that the moment they have produced their effects they may disappear without our being able to distinguish them, or they may become impotent by assuming another form. Others may be manifest to our senses, but elude our investigation ; and many, doubtless, lurk unseen, unknown, and defy our search.

ADVANTAGES TO BE DERIVED FROM THE STUDY OF THE CAUSES OF DISEASES.

But though the etiologist labours under this great disadvantage, and though his researches into the causation of disease must only too frequently be those of a passive observer, yet these researches are often capable of demonstrating the influence of causes on the disease they have developed, and of their capability of being neutralized or rendered less efficient.

In this respect, the knowledge we acquire of the nature of causes gives us a means of establishing a system of preventive or prophylactic treatment, which must ever form the most valuable and important department of Veterinary Science.*

ACTION OF CAUSES.

The antiquated maxim, *sublata causa, tollitur effectus,* does not always hold good in medicine; though in certain instances, as when a disease is maintained by a permanent cause on which it directly depends, it may be perfectly correct to apply it, as if we can remove the cause, the effects—which constitute the malady—will often disappear. Numerous examples might be cited in support of this. For instance, when the parasites which infest the animal body, either externally or internally, are destroyed, the symptoms to which they give rise may vanish; the removal of a calculus from the bladder or urethra will cause the manifestations of severe pain and disease which it occasioned to disappear; and the extraction of a foreign body from an otherwise incurable wound will lead to its final cicatrization.

* "To know the cause of a disease is sometimes to be able to *cure* it, often to be able to *prevent* it. In some cases the cause is beyond our power, but an acquaintance with its nature may teach us to remedy its consequences. There are many diseases, also, over which medicine has very little control, but the causes of which, when ascertained, may be avoided or extinguished. Such causes, when they do not happen to be removable by individual efforts, are often susceptible of extinction by the united measures of a community."—*Watson:* "Principles and Practice of Physic."

When a cause subsides spontaneously, the effects will, as a rule, subside in a like manner. But when causes have come into operation which excite much disorder in the vital functions, this disorder brings on other and different morbid states, which do not then depend on the original agents, but on the alterations to which these have given rise ; and these secondary agencies will not be effaced by the suppression or removal of the primary excitant. Even in such an apparently trivial matter as a suppurating wound in the horse's foot, caused by a nail in shoeing, we find that the abstraction of the nail does not lead to immediate recovery, but that secondary irritation is set up, and must be also removed, before a cure can be effected.

Though science cannot trace throughout the animal organism the various reactions to which certain causes give rise, because of their complexity and extreme subtlety, yet it may nevertheless be received as an established fact, that the agents to which the development of the various maladies are due, are as invariable in their effects or the results they produce, as those which occasion the most simple physical phenomena. "It is evident," says Laplace, "that a thing cannot exist without a cause sufficient to produce it. This axiom, known as the 'principle of sufficient reason' (*raison suffisante*), extends to everything." In the animal kingdom, no less than in the inorganic world, there can be no effects without sufficient causes ; the invariableness of causation is quite as applicable, and the sequence of phenomena follow with the same regularity and constancy, as in astronomy, chemistry, or the other physical sciences.

But the problem at which medical science has to work in seeking out and isolating these causes is no easy one. The philosopher is so far removed from rigidly applying the rules which govern the investigation of the physical sciences—that of connecting the factor with its product—that he can only at times seize, and as it were by chance, the last link in the chain of causation, and call it the generator of disease—the *corpus delecti.* And then we know not how often, nor for how long a period, the organism may have been exposed to its action, nor in what that action consists. And when we cannot

even claim to have tracked out a cause sufficiently potent, in our opinion, to account for the sudden appearance of disease, we attempt to cover our ignorance by saying that it is generated "spontaneously," which is something equivalent to declaring that it could exist without a cause. Nothing can be more unsatisfactory, although for the time being it may be convenient, and serve a useful purpose.

VARIETY OF CAUSES.

The causes of spreading, or even enzoötic, diseases are, many of them, yet to be elucidated. Their nature is unknown to us, though we are forced to admit their presence, either because of the morbid disturbance of a particular character which they occasion among animals inhabiting a wide expanse of country, or through healthy animals which have been in contact with the diseased becoming also affected in the same way, or by their having been exposed to influences whose presence can only be attested by the effect produced.

Great atmospherical or cosmical disturbances may, by acting directly on animal life, cause epizoöties, or indirectly, as in famines, by lessening the quantity or damaging the quality of the food consumed by them, or through emanations from decaying vegetable matter after inundations in warm climates, &c. Or they may be induced by some peculiar miasma; by emanations from the bodies of animals either diseased or too closely packed together; by a neglect of hygiènic laws; by exposure to severe hardship and tempestuous weather; by the introduction into the body of animal or vegetable organisms; or, finally, their outbreak may be largely due to the existence of the peculiar morbid constitution already described.

All these causes have been enumerated at various times to account for the appearance of wide-spread diseases; and while in some instances they have been received as satisfactory, and are sufficient to account for some of the phenomena observed; yet in others they have been rejected as altogether insufficient, or at least so uncertain as to be open to discussion. Sometimes we imagine we have all the elements necessary for the production of an epizoötic disease present and in full force,

and yet it does not manifest itself. Then we are driven to the conclusion that a something else is necessary—some *tertium quid*—to produce the desired combination between these elements: just as the electric spark is required to bring about a chemical union between hydrogen and oxygen in the form of water; or we are forced to admit that there must be a peculiar process of catalysis or amalgamation of these elements, or a conjunction of conditions with whose nature or mode of combining we are unacquainted.

This unknown factor, or whatever it may be, this *aliquid divinum* or epizoötic genius, will doubtless in time be discovered. In the meantime, we can only hazard the supposition that if it does not directly produce disease, it may at least intervene in the case of contagious maladies, and provoke their indefinite extension. Cattle-plague, foot-and-mouth disease, glanders, sheep small-pox, and other diseases of a contagious character, occasionally exhibit a greater tendency to spread, and assume a more virulent character, than at other times. It may also operate in favouring the recrudescence of maladies which had disappeared, or have only been present in a sporadic or enzoötic form.

The history of animal plagues testifies that almost every possible conjecture has been brought forward, from the earliest times up to the present, to account for these outbreaks: famines, inundations, abrupt or long-continued atmospherical derangements, severe winters, excessively hot summers, blights of crops, wars, the transmission of diseases from other regions, &c.; and also that many were ascribed to comets, earthquakes, planetary eccentricities, and other prodigies which seemed to affect the credulous minds of the chroniclers more than they could have done the general health of the animals with whose diseases they chanced to be coincident. It also shows that, and especially in the earlier centuries of our era, epidemic diseases not unfrequently preceded, accompanied, or followed the epizoöties of animals, as if there were a universal cause in operation; while at other times only animals would be affected, and the populations would thereby suffer directly or indirectly.

Modern investigation has done much to elucidate the conditions upon which the appearance and extension of some of these maladies depend, and has also made some progress in enlightening us as to their nature and the measures which may advantageously be adopted to abolish them or mitigate their destructive effects; but science, it may be truly said, is yet only on the threshold of discovery, and the indications she may from time to time be able to afford us will doubtless have the effect of modifying our views in several important particulars, and more especially with regard to the origin of these scourges.

GENERAL PREDISPOSING CAUSES OF DISEASE.

THE general predisposing causes of enzoötic and epizoötic affections, as we have mentioned, are to be sought for in the various localities where they appear, in the varying atmospheric conditions, in the seasons, the food, the water, and the many influences which man brings to bear on the health of animals by labour, and the artificial requirements of domestication.

They all play a more or less important part in establishing a constitutional aptitude for the production of disease; this sometimes cannot be satisfactorily demonstrated, but at other times it is readily so.

Epizoötic diseases have generally visited countries with a frequency and malignancy proportioned to the intensity of the predisposing causes, and in only too many instances it is by the suppression or removal of these causes that we can hope to contend successfully with such maladies. The measures which we adopt with this object in view belong to *sanitary science*—a very valuable, and, indeed, indispensable branch of medicine, which is immediately related to the preservation of health and the prevention of disease. We shall briefly examine some of the chief predisposing causes, then those

which immediately excite disease, before passing to the general measures necessary to prevent them.

THE INFLUENCE OF LOCALITIES.

No branch of veterinary science is more worthy of study, in investigating the predisposing or exciting causes of enzoötic or epizoötic diseases, than the influence of localities, with regard to their salubrity or insalubrity; for in addition to becoming acquainted with the maladies peculiar to them, we are led to examine the conditions on which the existence of these maladies depends, and may therefore be able to prevent them or hinder their extension.

When we know that each region, each soil, affixes an indelible impression on the nature and the physiognomy of the animals and plants which live upon them; that by its topographical situation, its configuration, elevation, geological and chemical constitution, the waters which irrigate it, lie on its surface, or flow as rivers through it; by the general condition of the atmosphere—its purity or contamination, the degree of transparency of the sky in connection with the amount of radiation from the ground, the temperature, humidity, prevailing winds, calms and storms, barometric pressure and electrical tension, as well as the vegetation that grows on it, and the kind of culture pursued—when we know all this, we may be satisfied that the character of a locality or a region possesses a great predominance over other causes in maintaining or disturbing the health of the creatures dwelling therein, and predisposing to, or exciting the advent of, various kinds of diseases.

Not only does locality, which, in one sense, is only another name for climate, predispose to diseases of the gravest character, but it often impresses distinctive features on those which arise in it or are imported. It is also a fact that in different localities, maladies—especially those of an epizoötic character—vary considerably in their intensity and power of diffusion, as well as in their rate of mortality.

According to the simplicity or complexity of the various predisposing conditions peculiar to locality, it is probable that

the prevailing maladies will be simple or complicated, or depend for their origin on one or several causes, if these directly excite disease.*

1. *Altitudeie.*

The altitude of different regions exercises a marked influence, not only on the tendency to various diseases, but also on their course, and sometimes on their character. The physiological action of atmospheric pressure, especially at great elevations, has been observed by numerous travellers in mountainous countries in every part of the world, and it has been manifested in the lower animals as well as in man.† Important vital functions are modified, especially those of respiration and circulation; probably because a given volume of the rarified atmosphere contains less oxygen, and, consequently, respiration has to become accelerated to compensate for the diminution. The inspirations and expirations are proportion-

* The illustrations in proof of the influence of locality are extremely numerous, and many will be adduced hereafter; at present we may only refer to an enzoötic malady of sheep, named the "trembling disease," "lumbar prurigo," &c.; which has been particularly observed to be affected by locality. According to Haubner, it prevails most extensively in low, damp valleys, subject to inundations or encircled by mountains, and provided with a luxuriant vegetation; as well as in sandy regions with a light soil and insufficient pasturage. In certain localities the malady has declared itself again and again, although the flocks have been repeatedly and completely renewed, and the greatest care has been exercised in their management; while it has gradually and entirely disappeared from flocks among which it prevailed when these have been removed to other regions. The ancient Etruscans appear to have been well aware of the effects of locality on the various creatures inhabiting it. When wandering about to discover a fit situation whereon to settle, their soothsayers caught and slew some animal in the locality which was likely to prove suitable, and made an attentive examination of its internal organs. If these were found to be healthy, then they at once fixed their abode there; but if any trace of disease was discovered in an important organ, they travelled on until their sacrifices gave them a more auspicious response. It is curious to find a similar custom existing in our own day among the Sea Dyaks of Borneo.

† For examples of this, I may refer the reader to a series of papers on the "Influence of Atmospheric Pressure and Altitude," published by me in the "Veterinarian," for 1868, pp. 277, 344, 375, 416, 492.

ately multiplied, the heart contracts more energetically and frequently, the blood circulates with difficulty, the lungs become engorged with that fluid, and the bloodvessels are so distended that aneurisms are often formed. The aqueous vapour likewise becomes diminished in quantity, so that the atmosphere of the higher altitudes is nearly always very dry, though the Mexican plateau, which has high mountains, is rather humid ; and having a great affinity for water, it desiccates the skin and the mucous membranes.

Miasmatic influences lose their power if there are no very extensive marshes at high levels, infusorial germs are fewer and more scattered, and the earth rapidly absorbs the heat of the sun, but as quickly radiates it.

The diminution of the atmospherical pressure at high altitudes may act on the health by leading to muscular and articular relaxation, and a tendency of the blood to stagnate or transude through the walls of the vessels, especially in the mucous membrane of the air-passages, and in the lungs and brain ; increased evaporation from the skin, and diminution in the activity of the kidneys, the diminished temperature of the air, together with the lessened calorific energy of the body, consequent on the altered respiration and more active evaporation, causing the organism to suffer from cold ; while the action of the sun's rays, being greater than in low-lying regions, is supposed to be more penetrating, and to irritate the eyes, brain, and spinal cord.

It has, therefore, been particularly remarked that with men and animals living in high regions, such phenomena as apoplexy, inflammation of the brain or its coverings, pulmonary hæmorrhage, inflammation or congestion of the respiratory organs, rheumatisms, asthmatic affections, and squamous diseases of the skin are frequent.* Tuberculous and emphy-

* Burton says that pneumonia is a very common and treacherous disease in the highlands of Brazil.—"The Highlands of Brazil," vol. i. p. 240. The same writer also remarks that when crossing the higher altitudes of East Africa, the caravans suffer very much from pneumonia and pleurisy.—"The Lake Regions of Central Africa," vol. ii. p. 318. See also for Mexico—Jourdanet : "Du Mexique au Point de Vue de son Influence

sematous disorders of the lungs are also common, with dilatation of the right side of the heart. At certain altitudes, in some regions, animals become much changed, and beyond a certain limit do not thrive.

Certain maladies, particularly those of an epidemic or epizoötic and an endemic and enzoötic kind, have their limits at particular altitudes, while others are modified and reduced in virulency. The "horse-sickness" of Africa is an example of this. In South Africa the horses are driven to the mountains to escape the disease (which only attacks solipeds), which prevails during the summer months in the lower districts, and carries off great numbers.* Other malarious maladies are unknown above a certain elevation. The "yellow fever," or *vomito prieto* of man is an example,† and anthracoid diseases of animals is another, though it offers exceptions.

In some regions more than 500 feet above the sea level, it has been asserted that many diseases more or less prevalent and fatal on the plains, are unknown. Cholera and Cattle-plague have been adduced as examples. With regard to the latter disease, it has been stated that in 1865-6 no outbreak was reported in Yorkshire above 1000 feet, and that it kept closely, if not entirely, to the lowlands and dales. In Norfolk, Cheshire, Staffordshire, and Buckinghamshire, it was most severe in marshy and low-lying districts. The Cotswold Hills in Gloucestershire, and the range of the Downs generally, as well as the uplands of Wilts, were specially indicated as

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sur la Vie de l'Homme" (Paris, 1861); Mühlenpford: "Mexico," vol. i. p. 350; vol. ii. p. 263; Burkhardt: "Reisen in Mexico," vol. i. p. 63; Smith: "Peru as it is" (London, 1835), vol. i. pp. 16, 272, 274; vol. ii. p. 247; Unanue: "Observaciones Sobre el Clima de Lima" (Madrid, 1815); Tschudi: "Travels in Peru during the Years 1838—1842" (London, 1847), pp. 276, 278, 296, 304, 309, 457; Hill: "Travels in Peru and Mexico," vol. i. pp. 159—163; Liguistin: "Journal de Médicine Vétérinaire Militaire," 1865-66-67; Shaw: "Visits to High Tartary," &c.; Forsyth: "Travels," &c.

* See a paper by me on this disease in the "Veterinarian" for 1868, p. 184.

† Humboldt: "Essai Politique," vol. ii. p. 69; Smith: "Peru as it is," vol. ii. p. 197.

escaping entirely, or with little damage. In the last century, Wilts altogether escaped a visitation of this terrible malady from 1745 to 1757, and Holland may be cited as a country in which it is most destructive and persistent. De Berg,* so long ago as 1776, pointed out that, in general, this scourge was much more fatal in low, marshy countries than in those of an elevated character.† When it visited Switzerland recently it does not appear to have reached any great altitude, though, owing to the energy of the Swiss government, it certainly was only a short time in the country. The disease is said to be unknown in Transylvania (2000 to 8000 feet elevation), though this region lies in districts which are frequently infected. In the high country south of the Danube, as far as the Balcan, Bosnia, Lessin, and Bulgaria it has not been seen. Renault even thought that the Steppe cattle, which are generally credited as the bearers of the pest, lose it in the Upper Palatinate and in Swabia, regions lying between 500 and 2000 feet above the sea level.

Sheep Small-pox appears to be much influenced by altitude, and to comport itself not unlike the Cattle-plague. It is the same with several other ovine disorders, notably the malady termed "rot," which, troublesome and often fatal in low localities, are seldom, if ever, apparent on mountain slopes or elevated plains.

But though some serious enzoötic and epizoötic diseases find a barrier to their extension in altitude, there are others which would seem to arise or be maintained in hilly regions. As in the human species, Goitre has been noted as prevalent among animals in hilly countries all over the world, but especially has it been remarked as affecting the bovine species in the Puy-de-Dôme, France. Carbuncular or anthracoid maladies

* "Mémoire sur le Typhus," 1776.

† Veith, however, declares that the Cattle-plague does break out in hilly regions, and that it is then all the more deadly.—"Handbuch der Veterinärkunde." Ampach also says that he observed the contagion to be more active on the mountains than the plains, and that the progress of the affection was more rapid.—"Praktische Lehre von den Heerde Krankheiten," &c. (Pesth, 1819.) The malady has certainly appeared in Switzerland.

are also not unfrequent in mountainous localities; and probably in consequence of the varied and sudden changes of temperature in the Alps of Central Europe, and also perhaps through the co-operation of some peculiar agencies, the contagious Pleuro-pneumonia of cattle has been fostered as an enzoöty from time immemorial until, through commerce, it began slowly to gain a footing beyond its home, and within the last forty years has spread over nearly the whole of Europe to Asia Minor, South and Central Africa, North America and the United States, Australia and New Zealand, by its contagious properties alone.

2. *Configuration.*

The configuration of a country has a very great influence in predisposing to or producing diseases, as it tends to modify all other influences. Plains differ in this respect, according to their height and extent. On elevated plateaus, we have the same influences at work which have been mentioned for elevation. They are usually dry, and are very often swept by winds and storms; when they are low, however, they are damp and malarious. Mountains differ, according as they are in isolated masses or in chains; if the latter, their influence much depends upon the number and formation of the terraces.

Valleys have an important bearing on the health of animals. Those which are funnel-shaped, or circular and enclosed, usually have a stagnant atmosphere, which is often charged with organic matter prejudicial to health; catarrhs, lung affections, and certain forms of Anthrax are more particularly noticed in these. Longitudinal valleys, or those whose direction follows that of a mountain chain, are generally more or less enclosed at their extremities, and consequently the air is seldom renewed in them; they are often damp, and as a rule are possessed of similar influences to the funnel-shaped valleys.

The transverse valleys, even if only directed from one terrace to another, have in general more slope, the lower extremity is larger, and the air circulates more freely; but if they open out on plains, on a lake, or on the sea, they are yet more favoured in this respect by morning and evening breezes, and are generally very healthy. They are not so, however, if

their inferior extremity admits impure or contaminated air, as in the valleys of the Maremma of Tuscany, the Quebradas of Peru, &c. Valleys, or plains broken up by valleys lying in particular directions, are visited by different diseases. In those which are traversed by winds from north to east, acute inflammations, especially of the lungs, catarrhs, and rheumatism predominate. In those exposed to winds blowing from the west and south, diseases of nutrition are more common.

The height, declivity, and direction of the sides of valleys are also important features to notice when considering their physiological and pathological influences on animals.

3. *Geological Formation.*

We are not yet furnished with sufficient data to enable us to arrive at any sound conclusions with regard to the influence of the geological formation of a country in the predisposition to disease. The only well-ascertained fact is, that when a permeable soil overlies an impermeable, granitic, argillaceous, or calcareous subsoil, and especially when the locality is basin-shaped, the rains filter through the vegetable-bearing strata, carrying with them organic matter, and are retained. These are damp localities, and when the ground is dried up by the summer heat, and cracks, and the moisture evaporates, effluvia are generated and disengaged, which may be pernicious to health. Putrid diseases, and especially those of an anthracoid character, may then become prevalent.

It is evident that if the soil is deficient in certain mineral constituents, the plants growing thereon will likewise be destitute of these, should they not be supplied from other sources. On the modern alluvial tracts on the banks of the Rhine, there is no phosphate of lime in the soil, and the waters of that river do not supply it. What is necessary for the growth of plants is derived from the atmosphere, which supplies no less than 400 grammes to each hectare, according to Barral, and which is deposited by the rain. In dry years, however, this supply fails, and the plants are therefore deficient in this most essential ingredient. The consequence is, that the creatures which consume these plants suffer more or less, and this

is now recognized as one of the causes of that special affection of the bones of animals in these regions, which has received the name of "osteoclasty."

4. *Marshy Districts.*

Marshy districts have ever been considered injurious to man and the domesticated animals, from their predisposing to, or exciting the advent of, particular diseases. Of all these animals, perhaps the buffalo is the only creature which can live in them continuously with impunity.

According to the seasons are diseases more or less frequent, serious in their character, or different in their features. When rivers overflow their banks and cause the formation of lagoons, or when a country is flooded in any other way, and especially if the land be of an alluvial or boggy nature, and retains the water for some time, the same effects are produced as occur near permanent marshes. Organic matter, in greater or less proportion, is always in a state of putrefaction in these situations, and more particularly when the temperature is elevated during the summer and autumn months, and when evaporation has nearly dried them up. Then is the organic material most exposed to the sun's rays, and becomes more rapidly decomposed.

It is at this time that animals located in these regions are most predisposed to the action of unfavourable influences, as their strength is diminished. It is supposed that during the night or the early morning, when the air is most heavily charged with these putrescent matters, their effects are most powerfully developed. It is certainly during warm or hot weather in such localities that serious enzoötic or epizoötic, and even epidemic, affections are manifested.

The vegetation of damp, marshy districts is, although abundant, watery, and contains, proportionately, but a small quantity of nutriment. The animals which consume it are generally coarse, lax in fibre, and ungainly. Their bellies are large, skins thick and shaggy; the horses are soft, have hairy limbs, and large flat feet, with thin, weak horn. Their temperament is lymphatic, and their constitution feeble. This

renders them predisposed to diseases of a low or asthenic type, attended with great debility.

As a rule, the diseases occurring in these regions, and which are due to the emanations and the local humidity, take on an enzoötic or epizoötic form, and generally prove most intractable and fatal. For instance, in the low valleys which are often submerged, and which margin the great rivers flowing through Southern Russia to empty themselves into the Black Sea and the Sea of Azof, every year there are mortal diseases of a typhoid, putrid, or carbuncular form among the domesticated animals. In Egypt, after the overflowing of the Nile and the submerging of the Delta, in the East and West Indies, and in the islands of the Indian Archipelago, maladies of a dysenteric and anthracoid character repeatedly follow the drying up of marshy tracts. In the vast marshes of Hungary, in Siberia, Corsica, Poland, in some districts of Germany, in Catalonia, Esthonia, Livonia, and Courland, in the Maremma of Tuscany, the Pontine Marshes, in Brescia and Mantua, in France in the low marshy districts of La Camargue at the mouths of the Rhone, in the provinces of Languedoc and Liége, in the departments of Charente Inférieur and Deux Sèvres, and in La Vendée, during the great heats of summer and autumn, similar phenomena are observed in the appearance of Anthrax and other enzoötic or epizoötic plagues.

Indeed, so markedly is this the case, that it has been generally recognized, by the most competent authorities, that the principal cause or causes of anthracoid diseases, which are undoubtedly contagious, are due to the emanations disengaged from the ground during the heat of summer, and to the modifications which plants undergo from this influence.

A circumstance worthy of attention in connection with this subject is, that not only is the bovine species predisposed to attacks of such diseases in their own country, but so peculiarly is their constitution altered, that after they have left these regions, and are transported into others of quite a different character, these maladies can yet, it would appear, be developed under the influence of occasional exciting causes. In this way, it has been stated that cattle brought from the un-

healthy Steppes bordering on the Black Sea, and travelled through Northern Russia into Poland and Austria, or carried by railway or steamboat into other countries, and exposed to great hardship and fatigue, contract the Cattle-plague, even after the long journeys they have made; as if the seeds of the malady were already in their system, and only required the effects of hardship to develop them. This consideration may explain much that is mysterious in the invasions of this disease. The same observation may be applied to the "Texan" Cattle-plague.

So marked is this occurrence, that the peasantry of the Kherson Steppes, where this dreaded disease exists almost permanently, believe it to have originated from the bites of the black spider, whose webs cover thousands of acres of land, and that, as herd after herd is driven to the northern markets, the pestilence is spread throughout Russia.

The belief in the spider poison causing this malady is, of course, erroneous; but the development of the fever as the animals are driven through these marshy regions, fatigued, half-starved, exposed to inclement weather, and having nothing but bad water to drink, thus producing a morbid condition favourable to the genesis of the disease, can scarcely be a fallacy.

A similar occurrence is noted in the fat cattle reared in the marshes of La Vendée and Charente Inférieure, which are often smitten with their native malady, Anthrax, when on their way to the Paris markets.

The influence of marshy localities in predisposing to, or exciting the development of, general diseases cannot be disputed. Certain maladies have a very marked affinity for such regions, and while some of them are contagious others are not. The poison or poisons—for we know nothing as yet as to whether there is only one or several kinds of deleterious matter produced, or whether, if there is but one, it is variable in its effects—are specific, and induce specific effects upon the body, generally producing what are termed intermittent fevers in man, and their analogues—anthrax affections—among animals. Salt marshes are

not, as a rule, so dangerous as fresh-water ones; both combined are said to be the worst.' They are most deadly in warm or hot countries, and at certain seasons, and are an obstacle to the progress of civilization. The air is the medium which conveys this marsh miasma, and the watery vapour held in suspension no doubt contains it. Hence we can account for the comparative safety of marshy districts during the day, and their danger between sunset and sunrise; for being given off abundantly from the earth's surface during the day, through the influence of the solar rays, and carried into the atmosphere, they are precipitated during the night in a condensed form with the dew, in proportion to the diminution of temperature that takes place.

The abundance or the rarity of rain renders more or less active the development of these pestiferous emanations. Rainy weather generally decreases them, and dry weather favours their production, there being most danger when marshes are in process of drying. According to Scheltma, quoted by Delafond, Anthrax only shows itself during dry summers in the low-lying and marshy localities of Vijbrit-Seradeel in Friesland. During the dry seasons of 1782, 1783, and 1799, 2800 head of cattle perished from Anthrax. In these places the disease is not seen when the weather is damp. This poison is sometimes so concentrated in hot weather, that it will kill animals as if they had been struck by lightning; while in winter it is much less violent, cattle sustaining two or three successive attacks, and even recovering by appropriate treatment; as if the effects of the miasma were considerably attenuated. But we shall return to this subject again, when treating of the specific causes of disease.

5. *Damp Localities.*

Damp localities doubtless predispose to, or generate, general maladies. These localities, ordinarily lying in the north of temperate countries, near the sea, and intersected by large rivers, are always more or less exposed to humidity by frequent rains, overflowing of the rivers, and dampness of the atmosphere.

When the soil is of a clayey, marly, or peaty nature, though it may be suitable for the growth of plants, it is nevertheless most insalubrious for animals. Water is retained for a long time on the surface, the air is moist, and pools and lakes are formed. A calcareous or sandy soil may be as dangerous, if, as is often the case, clay or peat underlies it at no great depth. When sand is pure for a good depth, it forms a very healthy soil; but when it contains soluble mineral matter, or decaying vegetation, or when a sandy district lies below the general level, it may be very unhealthy for animals.

Creatures inhabiting such places, usually have diseases of a sub-acute type, accompanied by debility; being predisposed to them not only by the humidity of the air, and the ungenial condition of the ground, but also by the forage they consume containing a large proportion of water.

Fodéré gives us an instance of an apparently favourable soil proving the opposite of healthy. In a tract of country near Strasburg, the nature of which was sandy and dry, a gangrenous Pleuro-pneumonia raged epizoötically among the cattle depastured upon it, for which no cause could be found except that it was contagious, and was propagated in that way. A careful examination of the soil, however, at length established the fact that a compact bed of clay underlay a thin stratum of vegetable matter carried through by the rain, and above this was the surface sandy layer. The wet, aided by heat, decomposed the organic substances, and the products of the decomposition being exhaled in vapour were breathed by the animals.

The "Black quarter" of cattle (*Erysipelas carbunculosum* —a form of Anthrax) usually prevails in this country on undrained retentive soils. The "Maladie de Sologne" reigns enzoötic in that central portion of France from May until the beginning of August every year, as well as in Chartres, Beauce, Champagne, Berry, Poitou, &c., chiefly because the soil is damp and the sheep are badly fed. "Rot" in sheep, which essentially consists in a dropsical condition of the body, and an enlarged and softened state of the liver, with the bile-ducts containing hydatids (the *distoma*, or *fasciola hepaticum*), occurs prin-

cipally on wet and undrained, or frequently irrigated lands, and is especially prevalent during wet seasons. Ophthalmia in the horse is often enzoötic in such localities, and assumes its most dangerous form—that in which the internal structures of the eye are most seriously implicated.

6. *Elevated Localities.*

Countries of a chalky formation, and which consist of elevated plateaus, when there is no impermeable subsoil, are the very opposite of those just described. The air is generally pure and dry, and the artificial vegetation is rich and abundant. The diseases in these districts are different to those enzoötic in humid regions. Inflammations run their course more rapidly and are more acute, and there is a greater tendency to congestion and apoplexy of various organs.

The same occurs on highly cultivated plains, where natural and artificial fodder is plentiful. Anthrax in its various forms is somewhat common, and other diseases, due to the predisposition induced by abundant and highly nutritious food and richness of the blood, prevail—sometimes with great severity.

INFLUENCE OF THE ATMOSPHERE, IN CONNECTION WITH CLIMATE.

Next to the influence of locality, or perhaps even before it, there is none so potent in its predisposing effects as the atmosphere; and it is popularly believed that there is no greater cause of enzoötic and epizoötic diseases.

The atmosphere is indispensable to life; it envelops and permeates the organism; it is the essential element of the highest as well as the lowest of the vital functions, and on its purity and other conditions does the health of the higher animals, at least, depend. So necessary is it to animals and vegetables, that the ancient philosopher, Thales, asserted that "living beings are only condensed air."

It may predispose to, or even excite, the development of epizoötic diseases, when some of its more important conditions are at fault; when its temperature is higher or lower than usual; when it contains more or less moisture than the bodies

of animals have been accustomed to; when it suffers exceptional perturbations, or its mutations are particularly sudden; or when it, or the moisture it contains, holds gaseous or organic bodies of a kind foreign to its normal composition. It is one of the most important agents in the propagation and diffusion of pestilences, by its perpetual movement and its elasticity.

When it has been for a long or unusual time stagnant, it gives rise to that state of the organism we term "predisposition," and in this respect it acts as a *predisposing* cause. But if it changes gradually and regularly, with no long periods of the same temperature, its effects are harmless, and, indeed, beneficial.

If its mutations, however, are very sudden or violent, it occasions diseases of various kinds, according to the nature of the change, and it then becomes an *occasional* cause. An abrupt change from heat to cold is, perhaps, the most frequent cause of disease, by acting on the capillaries and nerves of the skin; causing the former to contract promptly, the skin to lose one of its chief functions as a depurating and exhaling organ, and the blood to be driven to internal organs and textures—principally to the lungs and the membranes lining the air-passages and intestines. The former, especially, have the function of the skin thrown upon them, and suffer from congestions and inflammations; while the blood is inordinately charged with waste materials.

1. *A Hot and Dry Atmosphere.*

The air, when hot and dry, is, volume for volume, less heavy than when it is cold and damp. In such an atmosphere, animals are remarkable for their vigour and the density of their tissues. The cutaneous transpiration is abundant, but perspiration is rare, owing to evaporation taking place as rapidly as exhalation. Thirst is greater, and the circulatory and nervous systems are more active; so that animals are predisposed to acute disorders of these systems, and which withstand active depletive measures. A dry atmosphere is generally unfavourable to the spread of contagious diseases, and in a warm or hot atmosphere, epizoötic maladies are frequently complicated

by nervous symptoms, in consequence of the more excitable state of the brain and spinal cord. Animals of a bilious or irritable temperament are injured by a hot atmosphere, and tetanus and vertigo are frequent, as well as congestions and apoplexy.

2. *A Hot and Damp Atmosphere.*

When the atmosphere is hot and damp, it is much less exciting; the textures of the animal body are softened and relaxed, the cutaneous and pulmonary exhalations are diminished by reason of the less active evaporation taking place, and, as a consequence, the circulation of the blood is languid; the various organs receive their due quantity slowly, and are therefore less disposed to perform their functions. Evaporation from the skin is imperfect, and the perspiration accumulates on it on the least exertion. Vegetation grows rank and aqueous, and a large bulk requires to be ingested before sufficient sustenance can be procured.* All these circumstances modify the body, and predispose it to diseases of a particular character. Being unprovided, like man, with means to resist its effects, the animals exposed to these depressing influences are, more than he, liable to similar maladies; so that respiration, digestion, sanguification, enervation, and the other vital phenomena being impaired, the formative and eliminative processes are greatly hindered, and serious derangement is the consequence.

The days are hot, and the nights, perhaps, cold. These transitions expose animals to inflammation of the thoracic organs, especially those of the air-passages. Affections of the liver are also frequent and fatal; and other maladies may appear, which are due to the presence of extraneous gases or malarious matters in a very attenuated form, and which are, in

* Sir Samuel Baker remarks at Oboo, Central Africa: "My last camel died to-day; thus all my horses and camels are dead, and only eight donkeys remain out of twenty-one; most of these will die, if not all. There can be no doubt that the excessive wet in the food, owing to the constant rains and dew, is the principal cause of disease. The camels, horses, and donkeys of the Soudan, all thrive in the hot dry air of that country, and are unsuited for this damp climate."—*The Albert Nyanza.*

all probability, carried about in the watery vapour of the air. This vapour, when the high temperature is long continued, cannot be pure, produced as it is by the evaporation of surface water, which conveys with it the volatile emanations and miasma produced by the putrefaction of animal or vegetable substances, accelerated by the heat. Deleterious gases, and the lowest and most minute forms of organic life developed during decomposition, are thus spread over wide surfaces, and introduced into the bodies of animals by the air they breathe, the food they consume, and the water they drink.* In this way they gain access to the system, and by reason of their chemical, physical, or organic properties, they produce changes in the functions or composition of the most essential parts of the body; thus predisposing to, or exciting those epizoötic or enzoötic maladies which bear the distinctive designation of "putrid" or "septic."

This condition of the atmosphere is also favourable to the multiplication of myriads of harmful insects, which annoy animals, if they do not also produce or convey diseases. It likewise favours the evolution of that large class of maladies which is due to the presence of various kinds of entozoa.

In the Delta of Egypt, in South America, in the West Indies, in Hungary, the swampy parts of Russia, in Italy—especially in the Pontine Marshes—at Verona, at Mantua, and

* "Generally speaking, the average humidity of a season but little affects the production of parasitic fungi. . . . Such, however, is not the case with the class of moulds or such fungi as are reproduced through the medium of zoospores—these are undoubtedly less common in a very dry season; but it must be remembered that a single shower is sufficient for the development of zoospores, and occasional showers or heavy dews will speed them on their course of destruction as readily almost as continuous moisture. The large fungi, on the contrary, become very limited in numbers when the weather is unusually dry. . . . Experience has also taught us that many fungi flourish in proportion to the wetness of the season, or dampness of the locality. A wet year is always exceedingly prolific in fungi, and a dry season correspondingly barren, at least in many kinds, whilst others are exceedingly common. In a field or wood the mycologist reaps his richest harvest of mycological specimens in the lowest and dampest spots, in swamps, ditches, and ill-drained nooks."—Cooke: "Introduction to Microscopic Fungi," pp. 81, 158.

at other places, it has for a long time been observed that diseases due to blood poisons—such as Anthrax—prevail among cattle, and cause great destruction during this state of the atmosphere.

The winds, or other means of diffusion, may at times transport these unwelcome vapours and organisms to countries otherwise favourably situated, and so expose them to their pernicious influence. If these diseases depend for their production on living molecules, the same fortuitous circumstances which called them into existence may tend to maintain their generating power, even in the atmosphere, when carried about by aërial currents ; and thus these hurtful germs may not only be perpetuated, but indefinitely multiplied.

3. *Cold and Dry Atmosphere.*

A cold and dry atmosphere is generally very healthy, and but little likely to cause disease or to invite its attack. On the contrary, many epizoöties which do not depend for their maintenance on a contagious element, are considerably subdued, or even arrested, by the advent of cold, dry weather.

Cold with damp, however, suppresses some of the very important functions of the skin, diminishes the pulmonary exhalations, and is not favourable to health. Indeed, the whole of the animal functions languish ; respiration and circulation are enfeebled ; the blood is darker-coloured, the appetite is diminished, and digestion impaired. Consequently, diseases of a low type, but not the less grave, are common, being induced by the predisposition set up by these unfavourable circumstances. Affections of the air-passages and intestines, and rheumatism and kindred maladies prevail.

4. *Influence of Winds.*

The influence of winds on the health of animals is, of course, only an exaggeration of that of the atmosphere at its various temperatures and in a state of motion, and might be most appropriately noticed with the atmosphere and the seasons. It may, however, be observed that in all countries, but in some more especially, they are accused of producing

unhealthy conditions when they come from certain quarters at particular seasons. The hot and damp "sirocco" of various regions, though it does not continue sufficiently long to produce marked pathological effects, is yet very distressing to animals, in consequence of the cutaneous and pulmonary exhalations being checked, and the temperature of the body consequently increased.

There can be no doubt that, in some countries, the prevalence of certain winds has a great influence upon the nature of the vegetation and the condition of the animals inhabiting them; and may even prove destructive to certain species. The examples of this are numerous. We may mention those prevailing at the Falkland Islands, where, according to Clayton,* the winds from the north-east are moist, foggy, and unwholesome, and those from east to south are most pernicious, blighting, and tempestuous—affecting man, bird, beast, and vegetation; nothing exposed to their influence can withstand them. Happily, their duration is short, seldom continuing above twenty-four hours. But during their reign, they cut down the vegetation as if flames had passed over the ground; the leaves are parched up and crumble to dust. The fowls are seized with cramps, and never recover; but continue to decline till the whole side which was first affected is decayed. Hogs and pigs are suddenly taken with the staggers, turn round and drop, never to recover. People are oppressed with a checked perspiration, heaviness at the breast, and sore throats; though with care they soon recover.

And Pallas informs us that in the month of July, in the regions between the Don and the Volga, when the hot winds blow, many sheep perish. "They fall like flies, foaming with blood. They swell and putrefy so rapidly, that there is no time to remove their fleeces."† In other countries in which

* "Philosophical Transactions," year 1776, p. 99.

† "Voyages, &c." vol. vii, p. 357. Many instances of the influence of winds in producing or aiding in the extension of diseases will be found in "Animal Plagues." Their effects on the human species are abundantly illustrated in the writings of travellers, and those of medical authorities who describe climates and the topography of different countries.

hot winds prevail at certain seasons—as in Africa, South America, and Australia—similar effects are produced upon animals.

Winds also influence the spread of certain contagious diseases, as well as those which are due to miasma; and the oftentimes mysterious and erratic course of these may be ascribed to the intervention of aërial currents. This will be noticed hereafter.

5. *Influence of Fogs, Mists, &c.*

The appearance of fogs and mists has so frequently coincided with the advent of disease, either in the human species, among animals, or in plants, that it would appear idle to deny that they had some influence, if not directly, at least indirectly, in its production. Ordinary fogs are as hurtful to the lower animals, and especially when these are in a highly artificial condition, as to mankind. As a proof of this, we may refer to the effects produced on the Show cattle and others by the fog which prevailed in London in the middle of December, 1873. Of course, the action of such fogs is greatly aggravated by the products of combustion, effluvia, and other matters they hold in suspense. At certain invasions of Cholera, a blue mist has been observed; and a similarly-tinted fog has been noted during the prevalence of Anthrax, particularly the most interesting and curious epizoöty of Glossanthrax in 1682, which was heralded by a mist that travelled at a regular rate. Epizoöties and epidemies of Influenza, and other wide-spread maladies, have often been reported as occurring simultaneously with the appearance of mists and fogs, which not unfrequently have had a perceptible odour, and have consequently been qualified as "stinking." The peculiar atmospherical phenomenon familiar to country people as a "blight," affects vegetation in a very remarkable manner, as is well known. These aërozoids are, in all probability, germs of epiphytes, and possibly belong to the *Uredo* and *Penicillium* species.

6. *Electricity.*

Though atmospherical electricity is frequently assumed to have some connection with the development and progress of

certain epizoötic diseases, yet we have no evidence tending to prove that this assumption has much foundation. It has been frequently observed, nevertheless, that a thunderstorm has caused a notable diminution in, or even complete cessation of, diseases of this nature—Anthrax for instance. Epidemic Cholera has been recently believed to be connected in some way with the electrical condition of the atmosphere.

7. Ozone.

At one period it was imagined that in this modification of the oxygen of the atmosphere would be found the predisposing or exciting cause of disease; but up to the present time, too few facts have been collected to encourage the belief to any considerable extent. It is, however, a most powerful disinfectant; one six-thousandth part being capable of disinfecting 540 times its volume of air derived from highly putrid flesh; and it has also, it would appear, a decided effect in destroying the *materies morbi* of some diseases. A slight excess may cause catarrhal symptoms, or exposure to an ozone wind may have the same effect; for it has been shown that so small a proportion as one ten-thousandth in the atmosphere will render the latter extremely irritating to the air-passages, and indeed irrespirable.

This ozone is produced by electrical discharges during thunderstorms; by the friction of the air on the surface of the earth when winds prevail; and it is the product of plant respiration. Winds from the east and north-east—those which traverse the Asiatic Steppes with great velocity, and there become charged with the oxygen given off by the resiniferous trees—and which are submitted to great friction as they pass over wide surfaces of the earth, and are, perhaps, greatly charged with electricity towards the pole, arrive in our regions extraordinarily rich in ozone, and have consequently been considered by many authorities as the cause of Influenza and general catarrhal affections in man and animals. The west winds, on the contrary, after traversing the ocean, are poor in ozone, and no longer possess the disinfecting or purifying, power of that which is rich in this modified element; hence

under its influence, are developed typhoid and other putrid diseases.

An atmosphere rich in ozone may check or suppress a prevailing epizoöty, and exercise a healthy action upon living beings; while its absence or deficiency may be productive of evil. Ozone is more abundant in the atmosphere of the country than in that of towns, and this is, doubtless, one reason why the former is more favourable to the preservation of health, or its restoration when impaired; it also exists in larger amount in the air during spring and summer, than in the autumn and winter months.

8. *Atmospheric Cryptogams.*

The atmosphere may also act injuriously when it contains matters which are foreign to it; or when those extraneous agents which are commonly found in it exist in unusual quantity. The minute living organisms it contains in suspension, sometimes in great numbers, have also been, and in all probability justly, credited with good or evil attributes. In the atmosphere are the spores of cryptogamic plants, as well as micrococci, and the organic cell undergoing its different allotropic changes. We know, from the experiments of Hallier, that a cryptogamic sporule, placed in a little water, soon becomes distended, its nucleus quickly becoming transformed into a large number of granules, which, when the cell-wall ruptures, are thrown out and become so many mobile pseudo-vibriones: extremely minute round bodies furnished with a tail, and not unlike spermatozoa, and which have been sometimes described as *monas crepusculum*. These particles are so small, that a magnifying power of 1500 diameters is necessary to examine them, and their vitality is manifested by rotatory movements which, however, cease in a brief period; they then become a vegetable cell which grows elongated, doubled, multiplying to an infinite extent, and, according to the medium in which it is located, transformed into a "miccrocus," "bacterium," "leptothrix," "arthrococcus," "cryptococcus," "achorion," or "oïdium." It is these infinitely minute bodies which, as simple cells, staff-shaped particles, or *bacteria*, become the indispensable elements of "moulds," and more particularly of fermentation.

If they come in contact with albuminous matters, they readily attach themselves, grow at the expense of the nitrogenous element, and give rise to the most varied kinds of decomposition. These are the real agents in putrefaction ; it has been asserted that they will even attack rocks, and that through their influence the soil has been made. They are found in every drop of water, in every air bubble, and on every solid body ; they appear to be as necessary in the air as the oxygen or watery vapour ; they are the mysterious agents charged to purify the globe, according to some authorities, and govern in a salutary manner life and organic matter in general.

These cryptogams are drawn into the body with the inspired air, and so far from proving injurious to the individual, they serve a beneficial purpose. The *Leptothrix buccalis*, which Remak and Robin have described as a particular species, and which is found in the mouth of man and animals, is only formed of chaplets of the microccus that constitutes the ordinary mould, and is an allotropic condition of the *Penicillium crustaceum*, according to Hallier. This *Leptothrix* passes into the digestive canal, where, in the form of a microccus, it appears to be of great assistance in digestion ; and it is not transformed, neither does it perish, until after it has passed through the alimentary tract, and aided in the reduction and absorption of the food. Otherwise, these cryptogams are useful in the secretions and excretions, and they do not appear to have any injurious action on the animal body unless the equilibrium of the economy is disturbed by some cause or other. If animals have lost their vigour, these organic particles multiply to excess, and produce such effects as diarrhœa, dysentery, or other maladies due to cryptogamic intoxication. Their absence in an atmosphere which has become too dry, or in consequence of the occurrence of fogs, which throw them down, may also become a cause of disease in arresting some of the secretions.

These cryptogams are deposited on alimentary matters, and should these be in a favourable condition for their development, they multiply in the most extraordinary manner, producing mould or other alterations, and may in this way become

the cause of diseases. In certain conditions, not yet well defined, they, or rather particular species of microphytes, directly produce disease in animals, such as Ergotism, or in the plants on which these feed. We may mention, as examples, *Ringworm*, *Tinea favosa* the *Aphtha* of young creatures, and, perhaps, the Foot-and-mouth disease in animals; and in plants "the ergot," "smut" and "rust," the potato and beet-root disease, and the "oïdium" of the vine. Zurn and Hallier have found microphytes in Pleuro-pneumonia, Cholera, and nearly all the contagious diseases. The air usually serves as their medium of infection, and though they may, under special circumstances, be looked upon as instrumental in producing disturbance and disease, yet their general function in the plan of nature appears to be essentially conservative.

INFLUENCE OF THE SEASONS.

The influence of the seasons in predisposing to, or exciting, disease, has been remarked from the earliest times. The medical philosophers of former ages were much inclined to consider nearly all general diseases as originating in disturbed or irregular seasons. Galen imagined all pestilences to be due to the predisposition induced by impure air, insufficient food, or that of bad quality, and the exciting cause unseasonable weather. Hippocrates asserted that irregular seasons, by causing a pestilential state of the air, are productive of plagues. And since the days of these venerable authorities, all writers are generally agreed that intemperate seasons, or those which are irregular in their succession, are a common and evident cause of the more serious forms of disease.

Papôn considered the undoubted cause of Plague in man to be due to uncultivated lands, marshy soil, corrupt lakes, and filthy cities, concurring with occasional causes, such as *intemperate seasons* and famine. These causes, we may feel assured, are scarcely less powerful in engendering dangerous diseases in the lower animals. Nature has adapted their bodies to undergo a change internally, no less than externally, in accordance with the demands of the season. As with plants, so with animals. Their bodies are constituted to submit to

several phases or conditions, each suited to the time of year in which it is assumed. The physiological laws which govern these changes are immutable, and when subverted serious organic perturbations are the result. Thus, we cannot hurry an animal all at once from the condition in which nature had disposed it to meet the requirements of a hot summer's day, to the low temperature and chilling sleet and winds of midwinter, without exposing it to great peril. Nor yet could it be with safety ushered suddenly from its semi-hybernating state of December or January—with languid circulation, torpid functions, and thick heat-retaining robe—into the sultry oppressive weather of a seasonable July or August. It is but reasonable, then, to infer that creatures constantly exposed to the weather, should be liable to affections due to atmospherical vicissitudes, especially if the seasons should chance to be, as they frequently are in western countries, unseasonable. For it must be remembered that long experience has demonstrated that unseasonable weather is generally unhealthy.

SEASON DISEASES.

There are certain diseases, however, apart from those due to irregular seasons, which, assuming a wide-spread character at times, are then of an enzoötic or epizoötic type. In the winter and spring, for instance, there are what are called "season maladies," which, chiefly affecting the air-passages of the horse, give rise to catarrhs, bronchitis, pneumonia, pleurisy, or a compound of them all. These are due to sudden variations of temperature, and increased humidity of the air and soil. They are occasionally extremely prevalent, even when the air is cold and dry, and often cause a great mortality. This is more particularly the case when what we have designated the "epizoötic constitution" prevails.

They then assume a typhoid character, and have a tendency to grave complications. Their progress is often rapid, and so widely are they prevalent, that some authorities of repute imagine them to be, in certain years, contagious. The liability of the equine species to diseases of this character can no doubt be, to some extent at least, accounted for by the very artificial manner in which horses are treated; the mode

of utilizing them, keeping them in hot stables, with their bodies clothed, and their skin frequently denuded of its natural protection, which brings about a morbid sensitiveness to cold of this membrane and that lining the air passages, and which characterizes no other animals.

As the spring advances, if the weather be favourable, then these diseases assume a milder form, the symptoms are less complicated, and they are more amenable to curative measures.

Often the change of food ; always the variations of temperature, and sudden transitions from hot, badly ventilated dwellings to external cold, or the reverse ; excessive cutaneous refrigeration ; and the interruption to the exhalatory functions, are the predisposing or exciting causes of these maladies. Young animals suffer most, as they are more sensitive and susceptible, and diseases of the internal organs destroy large numbers.

The diseases of the summer and autumn offer a different character. Less frequent than those of winter, they would appear to be also, many of them, more benignant, though some are remarkable for their deadliness. Anthrax prevails extensively in many countries, especially that form known as "splenic apoplexy" in cattle and sheep, should the temperature be high ; intestinal and gastric catarrhs, diarrhœa and dysentery, and liver disturbance, are also noted, as well as affections of the brain and nervous system. Those maladies due to contagious or miasmatic influences are also frequently most prevalent in these seasons. Surface water is impure, often scarce (if there be a long continuance of dry weather), and this sometimes leads to great mortality. Inflammations have a tendency to assume a gangrenous character, particularly the Erysipelas of the sheep and cow, when the heat is intense.

Towards the end of autumn, diseases due to what are termed "chills" become apparent, such as catarrhs, rheumatism, &c., and dropsical and other atonic maladies are not unusual among sheep, from their feeding on low-lying or half-submerged pastures. The dews which fall heavy in this sea-

son, are also admitted to be productive of, or predispose to, disease.

INFLUENCE OF CHANGE OF CLIMATE AND LOCALITY.

A change of locality or climate has often a most marked effect in removing the predisposition to diseases of one class, and in giving rise to that which will favour the appearance of another.

The difference in what we have termed "climate," as well as nourishment and hygiène; the removal from a level to a mountainous country—from a hot to a cold region, or *vice versâ;* to a locality where food is scarce or abundant; to a place where shelter can be found all the year round, from one where it was perpetual exposure—all this must have a powerful influence in predisposing to enzoötic or epizoötic affections.

Young animals are more susceptible to these agencies than the adult or aged; and those creatures which are transported from northern to southern regions would appear to be more disposed to suffer than those which are imported from south to north.

An animal transported to another climate has, as it were, to become endowed with another constitution as widely different from the original as the new locality differs in its physical and meteorological aspects from the one whence it has been carried. This process, designated *acclimatization*, produces results varying in degree, not only with the nature of the climate to which the creature has been removed, but with the species of the animal—its temperament, constitution, age, &c. —as well as the rapidity with which the transition has been effected. For animals, like plants, have their particular zones; some are nearly or quite cosmopolitan, while others are confined to certain limits, beyond which they cannot be carried without great risk, unless an artificial climate is devised for their preservation.

Temperament and age, as already remarked, have much to do with acclimatization, young animals being most susceptible to the evil effects of changes of this kind; though adult and aged animals require a longer time to accommodate themselves to the new region.

This subject is full of interest and importance, though it is to be regretted that we know but little of the pathogenetic influences of acclimatization. British veterinary science, as yet in its infancy, has not been able to get beyond the very rudiments of its task, nor can it aid the comparative pathologist in solving questions which are of the utmost import. From the immense extent of our empire, embracing, as it does, every variety of climate, in every region of the globe, no country has such a splendid opportunity for adding to our knowledge of climate as it affects the health and diseases of the domesticated animals, and no country could have a greater interest in the subject ; and yet no country could have done less, or has done less, in this respect. We do not even know what are the diseases to which animals are liable in those countries. In the present state of our knowledge, we cannot pronounce, in anything like a definite manner, as to the nature of the influences which are at work to render acclimatization so difficult in some cases and not in others.

Cattle and sheep, driven from a locality where the natural pasture is neither very abundant nor succulent, to another where cultivation has made it particularly nutritious, are much disposed to be affected with grave maladies; and those animals which are removed from a healthy, well-cultivated region, with good pasture, to one of an opposite character, suffer in a similar manner.

Animals arriving in a country are more disposed to be attacked by diseases prevailing in that country than the indigenous creatures, and the attacks are generally more severe. This was particularly noticeable during the reign of the Cattle-plague in England in 1865 and 1866, when cattle sent from Ireland in a healthy condition were quickly and fatally affected, because predisposed, not only by the fatigue, starvation, exposure to the weather, and foul air of the cattle-ships, but also by the change of climate.

New arrivals in a country whose climatic conditions are very different to those of the region they have left, are often attacked by maladies to which the indigenous animals are

strangers, and which only disappear when they have become acclimatized.

Some enzoötic affections do not attack imported animals until they have been a certain time in the country. Splenic apoplexy, for example, is not at first one of the complaints of sheep removed to a region in which that malady is common; neither is "rot" in these animals. The sheep of Sologne, affected with Hæmaturia or Rot, are cured of these diseases when removed from that region (where these maladies are very prevalent and serious) to Beauce; and, in addition, are not affected with Splenic apoplexy (which is enzoötic there), when it prevails among the flocks. The latter also lose their predisposition to this splenic affection when they are driven to Sologne.

A change of locality, as has been mentioned, also changes the predisposition to many diseases, and may in this way avert them. The troublesome ulcer affecting horses in India and named by the natives "Bursautie," is often enzoötic on the plains, but is avoided, I believe, by removing the animals to the hills. "Kumree," another serious equine malady peculiar to Hindostan, prevails during the easterly winds, being evidently due to disease of the spinal cord, and accompanied by paralysis of the limbs, is also said to disappear on a change to the hills. The deadly anthracoid fever, to which cattle are predisposed on the Mexican coasts—the *calentura del piojo*, and which is readily transmissible to man—exists only there and in the *tierra caliente*, the predisposition being lost at a higher altitude.

Sheep disposed to suffer from "rot," are saved by moving them to dry, healthy pastures; and animals which are liable to contract diseases in elevated regions, are preserved by moving them down into fertile plains. In Italy, thousands of sheep and goats spend the winter in low marshy tracts where pasture is abundant; but their owners dare not trust them there in the summer, and therefore drive them to the mountains, where the pure air does not excite the predisposition to Anthrax, which may have been acquired below. In Corsica, too, at the commencement of the hot weather, the shepherds

emigrate with their flocks from the lowlands to the mountains and high plateaus, knowing well from experience that if they did not quickly leave the rank, damp pasturage which springs up at that season, they would soon lose nearly all their animals. The coarse-bred horses of Brittany, Vendée, Poitou, and other districts in France, which are so predisposed to attacks of specific ophthalmia, lose this liability when taken to drier, more elevated, and better cultivated departments, and receive better food. According to Lafosse, the horses of Berri have in general excellent eyes, though they are only *Poitevins* taken at an early age from their marshes, where every steed, before it has closed its career, rarely escapes becoming blind. And a change of locality in the anthracoid diseases of sheep and other animals appears to act like a charm.

The influence of change of locality or climate is not always favourable, however, as we have already mentioned; and a disposition to acquire disease, or to become physically degenerate, is often observed. The diseases which attack new arrivals in a country—the germs of which they may carry thither—are often very dangerous even to the acclimatized animals; as they frequently engender a virus or contagium which affects the latter, and which would not be developed in the "seasoned" organisms. As has also been remarked, a change of climate frequently proves an exciting cause of the diseases to which animals are predisposed, according to their species, breed, the reigning constitution, or the age of the animals imported. Lafosse observes that, according to the statements of several veterinarians, the cattle of Anatolia, as well as those of the Ukraine, Podolia, and Hungary, contract the Cattle-plague on leaving their native country.* And the same

* I do not for a moment wish it to be inferred that I believe in the spontaneous generation of Cattle-plague, at least in western countries. It is a fact, nevertheless, that it always appears in them as an imported disease, and manifests itself during the transit, or soon after the arrival, of strange cattle. Professor Zlamal, of Pesth, speaking on this subject at the International Veterinary Congress at Vienna, said they had the breed of Steppe cattle in Hungary, and that their herds were accustomed, like those of the Caucasian Steppes, to be out winter and summer in the open air;

authority draws attention to the fact that contagious Pleuro-pneumonia, and Aphthous fever (Foot-and-mouth disease), affect cattle soon after their departure from localities in which these affections are prevalent. "Strangles" and "glanders" also not unfrequently attack young horses submitted to emigration. English sheep of the more valuable breeds transported to France, are particularly liable to catarrh, chronic diseases of the lungs, and "rot;" they are also frequently attacked by ophthalmia, which terminates in the ulceration of the cornea. The contagious "foot-rot" of Spanish merinoes is supposed to be also due to change of locality. In the Maremma of Tuscany, where the mortality among the native sheep is not great, when compared with the noted reputation of the region for miasma, a thousand merino sheep were attempted to be naturalized by the government; but in the first year, out of the thousand, seven hundred perished.

Toggia reports that in Piedmont in general, bovine animals become diseased when they return from the mountains to the valleys, being affected with contagious Pleuro-pneumonia, which soon becomes epizoötic.* And Eandi informs us that in the valley of Varaita, in the same country, the cattle driven from the lowlands to the Alpine regions suffer from many diseases to which they are no longer liable when they descend again to the valley.†

In tropical countries these changes are, as might be ex-

indeed, in every respect their treatment was the same. He, since 1838, had nearly every year an opportunity of seeing the Cattle-plague, and for the first six years had done so without interruption, following it up step by step, and often in places where he was puzzled to trace the infection; but by consulting the calendar as to the times of the cattle fairs, and examining cattle dealers and others, he had always clearly traced out the foreign importation. It is only by inaccurate observations and inadequate investigations, that apostles have arisen who pretend that the "rinderpest" is of spontaneous origin in Hungary, without, however, being able to produce the slightest proof of the spontaneous outbreak of it. Since 1828, there had been three invasions; the first lasted until 1842, the second, in 1848, lasted until 1856; the third, in 1861, which still (1866) prevailed, all of which were clearly traced to importations.

* "Malattie del Buoi," vol. ii. p. 66.

† "Statistica di Saluzzo," vol. ii. p. 177.

pected, yet more prejudicial. Cutaneous affections are frequently very destructive among the creatures taken from the elevated regions of South America to the burning plains. For instance, Unanue remarks of Lower Peru: "The cattle reared on the mountains cannot support the climate of the coast, and when they descend they are attacked and perish. They quickly die, and when opened, the liver is found changed, and looking as if it had been roasted over coals. The butchers of Lima well know that the animals die much quicker in summer than in winter, and so they make their purchases during that season.*

If such changes in health take place in the same region, they must necessarily be more or less great should the animals be carried from cold or temperate climates to hot ones, or *vice versâ*. The strange disease, which appears to be a form of anthrax fever, and which is known as the "Spanish," "splenic," or "Texas cattle-fever," only becomes developed in Texan or Florida cattle travelling from south to north, and moving from one climate to another. A change of climate is supposed to have first produced what is known as "distemper" in the dog. This disease was observed in America as affecting dogs brought from Europe, a long time before it was seen on this continent; it appears to have been imported thence into Spain or England after 1760.† The extraordinary epizoöty among cats which manifested itself towards the end of the last century, seems also to have been imported from America, and to have had some relation to the influence of climate.‡

With some exceptions, it may be laid down as a rule, especially in the case of mankind, that the inhabitants of temperate countries are most easily acclimatized, as they are accustomed to wide and ever-varying influences; and that the natives of equatorial regions are less able to submit to changes, because they live under influences which vary but little.§

* "Topographie de Lima." † See "Animal Plagues." ‡ Ibid.

§ Grognier, however, says: "Take the animals you wish to acclimatize father from the south than the north. Individuals, like races, are more easily acclimatized in going in this than in the contrary direction. There is more vital force, more prolific energy, in hot than in cold climates. It

From the facts which might be brought to bear on this subject, there can be no doubt that the climatic influences which

is under the burning sky—though not excessively so—of Arabia that have been reared and maintained, from time immemorial, the finest breeds of horses in the universe. The most precious breed of sheep has been bred, if not in Spain, at least in those regions of Africa where, as in the European peninsula, the temperature is elevated. The zebus, the most vigorous race of cattle known, come from the banks of the Ganges, where winters are not felt. On the other hand, experience proves that it is always the Southern races which are acclimatized farthest from the equator—as is exemplified in the case of the Arab horse and merino sheep; while the French equine breeds have been spoiled by stallions from the north."—*Cours de Multiplication des Animaux Domestiques.*

This is only partially true, however, and applicable to France in particular; though with regard to fecundity, it would appear to be a correct opinion. Cows and mares, for instance, do not breed every year in England, nor in northern countries; in warm latitudes they not only do so, but they increase in prolificacy. A striking example of this is afforded by mules. In Central and Western Europe, as is well known, it is extremely rare for these hybrids to breed; but it is not so in Spain, where such an occurrence is somewhat common—while in the Antilles and South America, instances are by no means infrequent. But this author is much more correct in saying that the importation of individuals for the improvement of breeds is more likely to be successful than the importation of whole flocks and herds. "The improved breeds are acclimatized, while a transported colony tends, after some generations, to suffer from the effects of climate; it loses its characters, and becomes confounded with the indigenous races. We have seen whole families of Norman and Limousin horses which had been carried to Brittany and Champagne produce little better than *Brétons* and *Champenois* (the native breeds), and which had not even the good qualities of the indigenous races. It has also occurred that horses and mares of Eastern blood, though there was no crossing, have yielded nothing, after the second or third generation, but French horses."

Space compels me to omit many most interesting facts with regard to the influence of climate on the lower animals, and I can only in this case refer to the following, among many works :—

Darwin. Voyages of the Adventure and Beagle, vol. ii. p. 248.

Humboldt. Personal Narrative, vol. ii. p. 50, *et seq.*

Hooker. Himalayan Journals, vol. i. p. 60.

Secretain. Clinique Vétérinaire, vol. xvi. p. 471.

Ulloa. Relacion Historica del Viage a la America Meridional, Madrid, 1748.

Pridham. The Mauritius and its Dependencies. London, 1846. Vol. i. p. 237.

may operate in altering and modifying the organization of animals, are also potent agents in predisposing, or even occasioning, diseases of various kinds; and that these influences may act more markedly and promptly in some species, or even in individuals of a species, than in others.

INFLUENCE OF FOOD.

The very important part assigned to aliment in building up and sustaining the healthy body cannot be too closely investigated when that body is suffering from disease, and when it is suspected that the balance of vital action is deranged by an inadequate or deteriorated supply of the material out of which organization fashions so many diverse forms and textures, and produces such a multiplicity of movements and acts.

The influence of food in predisposing to, or exciting, diseased conditions is very great. When animals obtain as much food of a proper quality as will suffice to compensate for the losses sustained in the various operations of the organism, or, if they are growing, as will add to the fabric as fast as nature demands, then the harmony of their component functions is not disturbed, so far as their pabulum and heat-giving requirements are concerned. Animals then preserve their energy, their form and activity, and all the movements of the living machine are executed with regularity and ease. But if, from any cause, these materials are not furnished in sufficient quantity, or of

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Schomburgh. History of Barbadoes, p. 168.
Percival. The Island of Ceylon, p. 283.
Raffles. History of Java, vol. i. p. 110.
Marsden. History of Sumatra, p. 115.
Marco Polo. Narrative of Travels. London, 1849. P. 269.
Wanderings in West Africa. London, 1863. Vol. i. pp. 153, 239.
Clarke. Topography and Diseases of the Gold Coast, p. 50.
Burton. First Footsteps in East Africa, p. 220.
The Albert Nyanza, vol. ii. p. 91.
Wrangell. Expedition to the Polar Sea, pp. 29, 30.
Pallas. Voyages, vol. 5. p. 88.
Erman. Travels in Siberia, vol. i. p. 220; vol. ii. pp. 41, 76.
Kane. Arctic Explorations.
Blumenbach. Life and Works. London, 1865.

proper quality ; if they have been deprived of some of their principal elements, or have become so deteriorated that they cannot replace or repair the losses incurred by the wear of organs and the development of vital acts, the equilibrium which should exist in the animal body is disturbed ; debility ensues, textures lose their normal consistency, one system of organs is maintained at the cost of another, morbid alterations occur, and disease is produced.

1. *Food Deficient in Nutriment.*

Food deficient in nutriment gives rise to a condition which favours diseases, whose salient characteristic is debility. Plants may be full-grown, and yet contain but little nourishment. From bad cultivation or improper care, they may also be destitute of the qualities necessary to maintain healthy existence : or they require to be consumed in such large quantities as to weaken the digestive organs. In this case, of course, the effects are purely local, and the consequent maladies will be sporadic or enzoötic.

2. *Food of a Bad Quality.*

But the food of animals may be of a bad quality, arising from some temporary accidental cause, which may, nevertheless, extend itself to many provinces or countries. Rainy seasons, for instance, may destroy or damage vegetation, by submerging meadows and pasture lands, or by rendering the plants too aqueous in their nature. History affords us numerous examples of this. It must be remembered that the nitrogenous elements of plants are readily soluble in water, and may therefore be removed by wet. Hay, straw, and other forage may thus be affected, and not only lose their nutritive qualities, but acquire abnormal properties, becoming mouldy, blighted, heated, or infected with cryptogamic growths belonging to the *Uredo* or *Puccinia* species, and termed "rust," "bunt," and "smut" or "dust-brand," or "blue-mould" when due to the *Mucor mucedo.* These cryptogams confer on this kind of aliment, in certain circumstances, properties very prejudicial to health.

Under unfavourable conditions, oats may be affected with parasitic fungoid growths, wheat and rye with the "ergot," and so on ; all of which parasites grow at the expense of the grain, and besides robbing it of its nutritious properties, frequently substitute others of an injurious, or even poisonous character. In this way aliment either predisposes to, or directly causes, what may be wide-spread maladies, often of a serious type, but particularly those of the intestines, or even of an anthracoid nature, due to the induction of a septical state of the blood, which becomes altered in quality.

The subject of the diseases of plants, in connection with the health of animals, is of much interest and importance, and I much regret that, in this brief sketch of the etiology of maladies, I cannot refer to it at greater length. There can be no doubt that the existence of "enphytozics" (diseases arising within plants from the presence of fungi), and "epiphytozics" (*ditto* outside plants), as well as a sickly state of the plant itself, without the presence of fungi, greatly influences the sanitary condition of the animals consuming them as food. Thus it is that the history of animal plagues gives us numerous examples of enzoötic and epizoötic diseases being prevalent, coincidently with an unhealthy condition of the vegetable kingdom. In some years it has been observed that all plants were more or less affected—in other years only families ; while, at other times, only genera or species were involved. Epiphytozics, like enzoötic affections, are at times limited to a very circumscribed locality, and on other occasions, like epizoötic diseases, they are spread over entire continents.

Forage or pastures submerged during the overflow of rivers, and covered with slime and mud, are not much less injurious—severe dysenteries, intestinal derangements, and other diseases being frequently attributed to this cause ; and it is often the same with the herbage which grows on low, wet, impermeable land where there is no drainage.

Aliment altered in this way may occasion outbreaks of wide-spread disease, and the records of animal plagues shows that these have been neither few nor far between. It is well known that severe diuresis, or even a form of albuminuria, is often in-

duced when the herbivorous domesticated animals are fed on musty oats or hay, which have been damaged by wet weather or other causes. Such effects have been particularly noted for several centuries, but in recent times they have been more especially remarked. In the Rhine provinces in 1845, in Paris in 1850, in Holland in 1851, and in several departments of France in 1855, the losses caused by musty hay were serious and wide-spread. Oats rendered mouldy by the presence of the *Aspergillas* fungus are reported to have caused paralysis in horses, wasting of the muscles, amaurosis, debility, and death. Musty hay produces similar effects, chiefly as the result of indigestion, which may also induce symptoms of vertigo and attacks of delirium, with diarrhœa and hectic fever. Glanders and Farcy are frequently caused by forage of a bad quality. Mildewed fodder has been blamed as one of the chief causes of alarming epizoöties.

In Germany, it has been observed that during a summer when leguminous plants were very subject to honeydew, all the horses which received them as food, and which were white, or had white patches on their bodies, had inflammation and sloughing of the light-coloured skin, the dark portions remaining healthy. A disease of a similar character—a variety of impetigo—has resulted from feeding horses, cattle, goats, pigs, and young sheep on buckwheat, which may have been altered in quality.

In animals fed on "rusty" straw, sickness, disease, and death have been produced. The rust-spores of the parasitical plant, the *Uredo rubrigo*, are oftentimes found in the lungs, even in a state of active growth—showing what a wonderful power of development they possess, and what an amount of irritation they may cause in the body.

Bread which is covered with a reddish mould (the *Penicillium roseum*), or one of a bluish-green hue (*Penicillium glaucum*), has been productive of disease in mankind and horses. The serious panzoöty of 1690, described by Ramazzini, was attributed to the rust on the wheat, oats, and other plants.*

* For this and other descriptions of animal and vegetable diseases, reference must be made to "Animal Plagues."

The "ergot" on rye, wheat, &c., has also given rise to extensive disease in man and animals, including birds, marked by convulsions, paralysis, dry gangrene of the limbs, loss of hair and horn, and other strange phenomena.

The Pellagra of Italy, as affecting the human species, is ascribed to the maize parasitic growth, the *Ustilago maidis*, and its effects on animals are not unlike those produced by the ergotized rye, with the exception of gangrene; the hair is shed, the muscles of the limbs waste, there is more or less paralysis, diarrhœa, and looseness of the teeth. The same smut is often very prevalent on the American continent, and gives rise to what is termed the "dry murrain" of cattle. The debilitated condition of the negroes and other dwellers on the western aspect of the Sierra dos Organos, in the Brazils, and designated "intertropical anæmia" by Sigaud, has also been reported as due to this cause.* The affected negroes lose their dark hue. The malady is also seen in the southern parts of Colombia.

The flesh of creatures affected with blood diseases, such as Anthrax, when given to carnivorous animals, is very hurtful, and may occasion acute maladies, and even prompt destruction. Flesh in a state of putrefaction may also give rise to serious gastric and nutritive derangement.

3. *Sudden Change of Food.*

The conditions of digestibility and assimilation have, of course, much to do with the production of disease. For instance, supposing the food to be quite healthy, a sudden change from poor to that of a rich quality may occasion much derangement. In sheep no class of affections is more common than that due to this cause; in cattle it is the same, and the horse is not exempt from such disturbances. The indigestibility of different kinds of food at certain seasons, or in certain conditions of the system, is notorious. The evil effects appear to be induced, in the first place, by the retention of these matters longer than usual in the stomach and bowels;

* Diseases of Brazil.

during which delay, aided by moisture, the temperature, and the ingested air, chemical decomposition sets in ; this gives rise to distention, irritation, and other consequences. The reduction of the alible portions of the food may be but partially accomplished, and the nutritive matters may find access to the blood in an improper condition, and thus produce nutritive disturbance and disease. Food containing an inordinate proportion of ligneous matter is also prejudicial ; and an excess of aliment is not without its drawbacks, in inducing certain conditions favourable to more or less serious disorders due to plethora.

A sudden change from one kind of food to another may induce sporadic, enzoötic, or even epizoötic disease. The barley, maize, wheat, or rice which may have to be given, instead of oats, to army horses on active service may act in this way. The inflammation of the vascular structures of horses' feet, termed "laminitis," is not unfrequently occasioned by this change ; and in Provence, the splendid mules brought from Poitou very often die in great numbers, soon after their arrival, from disease supposed to be caused by change of diet.

An excess or deficiency in some of the chief constituents of the food may also predispose to, or occasion, organic disturbance. Deficient in nitrogenous elements, wasting and debility result ; an insufficiency of hydro-carbonaceous matter tends to a similar condition ; when the earthy salts are not in due proportion, marked changes are produced ; if deficient in the food of growing animals, the skeleton is imperfectly developed, and in adult animals the bones become diseased. Hence we have "rickets," "osteoporosis," and the enzoötic Arthritis and paralytic disease of foals, calves, lambs, and pigs, due to a diminution of the mineral matter, and particularly to the phosphates, in the food. The strange outbreak of "osteomalacia" which attacked the bovine and porcine animals in Bohemia and other countries in 1865 and 1866, has been ascribed to the insufficiency of phosphate of lime in the aliment. If the mineral matters are too abundant, then we may have an opposite condition.

4. *Artificial Food.*

It is still a matter for discussion how far the more artificial kinds of food given to animals, but especially to the bovine and equine species, may tend to disturb or diminish the vital functions in such a manner as to produce a state of the organism capable of generating, or favouring the advent of, general diseases. Much could be said for and against the use of this food, and there can be no doubt that the more artificially animals are fed, the more artificial do we make their bodies—removing them further and further from their original healthy condition, and making them amenable to influences which at any rate tend to modify, if they do not weaken, those functions on which health depends. The more we subject them to those influences, the more must we compensate for their altered state by judgment in general management. When this judgment is not exercised, or is thwarted by unlooked-for and occult influences, then the reaction which takes place in the animal body will be in proportion to the degree in which its natural life has been supplanted by an artificial one. Food of a very nutritious and stimulating quality is no doubt necessary for the preservation of health when the waste of the body is equivalent to the quantity given ; but when it is allowed in too great abundance—when it is much beyond the necessities of organic repair—then, as has been said, it may pave the way for the advent of grave distempers, and a highly excited condition of all the functions.

An enzoötic disease of horses in Egypt, which is chiefly characterized by softening of the liver, has been traced to their being fed on the trefoil (*Medicago tupulina*), which may be termed an artificial food. The too abundant use of the flesh-coloured clover (which is not, however, artificial), as forage for horses and ruminants, is said, by Röll, to produce cutaneous eruptions, and in the sheep Encephalitis. Potatoes in large quantities, and given continuously, produce Diarrhœa, sanguinolent discharges, Enteritis, and death ; with bovine animals, they occasion a particular eruption on the skin of the pastern, and sometimes abortion ; and, if allowed constantly,

favour the development of cachectic and dropsical affections, Chlorosis, Osteomalacia, &c.

The residue of malt or potato distillation (grains, draff, &c.) have been, particularly on the Continent, accused of causing gastric derangement; if acid they induce Diarrhœa and Enteritis, and, if long continued, a pruriginous affection of the posterior limbs. In Belgium and other countries, this residue has been looked upon as one of the causes of the contagious Pleuro-pneumonia of cattle. When not completely deprived of alcohol, it causes intoxication, and inflammation and hæmorrhage of the brain and its coverings.

It must not be forgotten that the influence of aliment on the health of the domesticated animals, be it deficient in quantity or quality, altered in its composition by having new elements of a pernicious kind added to, or substituted for, those which the system requires, *minus* one or more of its elements, or of a highly artificial kind, is not always immediately apparent. On the contrary, observation has demonstrated that the injurious effects of such food sometimes remains concealed for some time, and then may be only exhibited when circumstances occur favourable to the evolution of disease. Thus, as Delafond points out, it is not during great privations in the quality or quantity of forage during war that horses are most liable to suffer from actual disease, but when, after peace, they again have their full allowance of nourishing food. Glanders and Farcy, which have so often been ascribed to bad forage and exposure to the weather, do not always manifest themselves immediately, but may break out suddenly some time after horses have been subjected to the morbigenous influences.

Cattle and sheep are far more susceptible to the attacks of certain diseases after the long privations of winter, when they again receive abundant food in the spring, than at other times. The sudden alternations of abundance and famine, or *vice versâ*, are, perhaps, the most frequent causes of some enzoötic maladies among certain of the domesticated animals.

5. *Pastures.*

In connection with food, the influence of pastures must not be overlooked, as a large proportion of the domesticated animals derive their aliment directly from these. The situation and the soil of pastures are of most importance in this respect, as on them the nature of the vegetation depends to some extent; as well as the degree of exposure to the weather, and other circumstances. The sheep fed on salt marshes or pastures, are very rarely affected with Rot. Low-lying pasture-land is at certain seasons prejudicial to the flocks and herds feeding on them, and especially that which is liable to be inundated. Elevated grazing-grounds exposed to the sun, and without the shelter of trees, is also hurtful, not only from the distress animals experience at mid-day, but from the fact that the plants become dried up and indigestible.

6. *Dew on Pastures.*

Pastures covered with hoar-frost or cold dews, if frequented by animals, are liable to cause what are called "chills" and gastric disturbance, should the creatures be turned upon them while fasting. This result is well known in various countries.

The destructive "lung sickness" *(Pard Zickte)* of the Cape of Good Hope and South Africa, is believed, and not without substantial proof, to be engendered by the dews which fall on the grass at a certain season; and according to Burton, the natives of Central Africa assert that dew-wetted grass is unwholesome for cattle.* It is not unlikely that the dew of itself is not injurious, and that the evil effects attributed to it are owing either to its low temperature, or its containing decomposing organic matter in a state of solution. This would most probably be the case in marshy localities.

The morning dews have been blamed by shepherds for causing Abortion and Anthrax fevers; and those who attend to the Merino sheep in Spain do not turn out their flocks to graze, from January until June, until the sun has dispelled the dew, for fear of the "basquilla" (Anthrax fever).

Corrosive dews have been accused of causing the outbreak

* Lake Regions of Central Africa, vol. ii. p. 12.

of epizoötic diseases among cattle, and "honey-dew" has been supposed to occasion aphthous and other affections. Intelligent agriculturists in Saxony have remarked this dew as a cause of epizoöties, and the shepherds take the precaution of leaving their crook on the grass on driving home the flocks, and examining it in the morning before driving them out again. If they observe the dew which has gathered on the crook to be only water, the flocks may then be allowed to pasture; but if it resembles oil or honey, then they must remain until the dew has been evaporated.

7. *Plants on Pastures.*

The influence of the different kinds of plants growing on pasture and meadow-land in the production of disease, cannot be noticed in this place, though the inquiry is not without interest. Neither can the effects of noxious plants be alluded to, further than to mention that some of these can be eaten by one species of animal with impunity, and not by another; that, as a rule, animals instinctively avoid hurtful plants, and unless urged by hunger, or through being strange to the region in which these grow, refuse to eat them; and that animals accustomed to some varieties of poisonous plants can ingest them without injury, while new arrivals are destroyed thereby.*

We have said sufficient, perhaps, to demonstrate that, according to the kind of alteration to which alimentary matters have been submitted, so do they predispose the animals consuming them to serious affections, and not unfrequently excite the development of these. More frequently, however, they merely

* As examples, we have the *Andromeda ovalifolia* of the Himalayas, which poisons sheep and goats (*Cleghorn:* Journal of Agric. and Hortic. Society of India, vol. xiv.), and the *Rhododendron cinnabarium*, mentioned by Hooker (Himalayan Journals, vol. ii. p. 151); the *Erba* in Tongut, alluded to by Marco Polo; the *Kalmia angustifolia* of New England, spoken of by Marsh (Man and Nature, p. 40); the *Tutu* plant of New Zealand; the perennial *Lobelia pratioides* of South Australia; the "milk sickness" plant of the United States of America; the *Adenia venenata*, spoken of by Schweinfurth (Heart of Africa), and other plants described as existing in Africa. In Britain we have also many examples of plants poisonous to animals.

act in modifying the constitution in such a way that various occasional or determinate causes may give rise to as diverse maladies, whose general characters are based on a great organic change throughout the body, which frequently endows them with a malignity not observed in ordinary diseases, and in individual cases often transforms a simple injury into one of a grave nature.

It must not be forgotten that the food often serves as the vehicle for the introduction of animal organisms which, as we shall see hereafter, may become a source of disease.

INFLUENCE OF WATER.

Water, by entering so largely into the composition of the animal body, and being so necessary for its well-being, may have much influence in averting or inducing disease, as it may happen to be pure or impure, plentiful or scarce, or holding substances in solution or suspension which are in undue proportion, or of a pernicious character.

From their having no other liquid wherewith to assuage their thirst, the water animals are allowed to drink should possess those qualities known in hygiène as "potable"—that is, it ought to be clear and limpid, without taste or smell, capable of dissolving soap readily and boiling peas, and it should contain air. The best is that obtained from shallow, sandy rivers.

1. *Temperature.*

The effects of its temperature in predisposing to, or exciting, disease are not so well marked, perhaps, as some of its other qualities. When very cold, and especially when it is eagerly drank by animals exhausted by travel or fatigue, or inordinately heated, it may occasion serious internal inflammations and disorders of the skin and feet. When taken at a comparatively high temperature for some time, it produces debilitating effects, relaxing the digestive organs, and predisposing to catarrhs of the alimentary and respiratory passages. Many affections witnessed in animals during hot seasons in some countries—such as Diarrhœa, Dysentery, and Jaundice—are attributed to their drinking water much heated by the sun.

2. *Quantity.*

A plentiful supply of good water is most essential to the welfare of animals, as, from its importance in the economy, the quantity necessary for their sustenance cannot be much diminished with impunity. To keep them in health, they should never suffer from thirst. The most injurious results ensue when, from unfavourable seasons, the conformation of a country, or the neglect of man, these creatures are unable to satisfy their wants in this particular. Inflammatory and Anthracoid affections, Constipation, and a diminution of the secretions and excretions, are the result. In the Russian Steppes, it is during seasons of drought that Cattle-plague and Anthrax diseases more particularly prevail. And in Ceylon, the Cattle-plague has been most frequent and destructive in droughty seasons. Different species of animals require different allowances of water, and the nature of the diet has some influence in this respect; but all need a larger quantity in youth than in old age, with dry than moist food, in a hot than in a cool atmosphere, and as evaporation is rapid and the labour fatiguing.

Too large an allowance of water causes indigestion and debility, and in certain animals dropsy; while a sudden change in the quality often produces alterations in the body, and induces symptoms of disagreement.

3. *Earthy Salts.*

The influence of water containing too large a per-centage of earthy salts in solution will, of course, depend upon the nature of the salts.

Hard water, containing more than ten or twelve degrees of hardness, affects the alimentary canal, causing Constipation or Diarrhœa, and producing a dry skin and rough staring coat. Colic is also not infrequent in horses unaccustomed to it. Rossignol states that water highly charged with carbonate and sulphate of lime was found to give rise to exostoses in horses; pure water being given, the bones ceased to be diseased.* Young horses, according to Dudfield, have been

* Traité d'Hygiène Vétérinaire. 1857. Page 357.

attacked by bony tumours on their limbs, in the situations where they usually form as a result of injury, through drinking water highly charged with calcareous salts.* It is also said that sheep, cattle, and horses are particularly liable to urinary calculi in limestone districts. A regiment of cavalry stationed at Paris, in 1804, had an enzoötic, or rather epizoötic, disease prevailing among the horses, which occasioned much loss. The Veterinary School at Alfort was appealed to, and it was decided that the cause of the disorder lay in the water. So instead of using that which had been obtained from wells, a supply was brought from the Seine, and the malady ceased. A careful analysis made of the well water showed a very great excess of sulphate of lime.

Butyrate of lime has been known to cause Diarrhœa in men and animals.

In the vicinity of the Isère, where, according to Granges, magnesia is in large quantity in the water, horses and mules are said to be affected with Goître.† Rey, however, denies this. It is certain, nevertheless, that a large number of ob-

* The "Veterinarian."

† Comptes Rendus de l'Académie, vol. lv., p. 475.

M. Baillarger, physician to the Bicêtre, in Paris, found in a number of places in the departments of the Isère and Savoie that the greater number of mules had an immense hypertrophy of the thyroid body, and much larger than that generally seen in man. In one stable in Modane, amongst twenty animals, nineteen were affected with the disease; and of all the mules examined, only one-third was free from it. Amongst horses, Bronchocele is not nearly so frequent, but still much more so than is generally believed. In one place seven horses were examined, which were well fed and cared for, and lodged in light and well-ventilated stables; and yet four of them had Bronchocele. The same disease was found to exist, in a diminishing ratio, in dogs, cows, sheep, goats, and pigs. The prevalence of the tumours in the domestic animals is no doubt due to the same endemic causes which produce them in man. The fact that it is most frequent in mules is in so far interesting as these animals are sterile, and sterility is a characteristic feature of cretins. It is asserted that the drinking water of La Maurienne rapidly produces hypertrophy of the thyroid body; and young men liable to the conscription are known to make use of this means to escape military service.

Sigaud gives a striking instance of the influence of water in producing Goître. *See* "Maladies du Brésil," p. 85.

servers attribute the presence of Goître to the use of certain kinds of water.

Water impregnated with sulphurous acid gives rise in cattle, and in other animals, to a number of serious symptoms, particularly to disease of the bones. Heu supposes that it may be generated by the reduction of earthy sulphates by organic matter. The water which passes from certain manufactories may contain an excessive quantity of deleterious matter.

Rarely, too, streams may be impregnated with substances which, though derived from the soil, are unusual, and may occasion enzoötic disease, or render the locality quite unsuitable for animals. The *Malum Aleporum*, a tubercular disease of the skin, peculiar to Bagdad, Aleppo, and other towns on the banks of the Euphrates and Tigris, and attributed to the use of water from a particular stream, attacks dogs and cats, as well as the human species. Burton says that at Zayla, a large Somal town on the East African coast, all the pits within the walls supply brackish or bitter water, fit only for external use, and that this is probably the reason why vegetables are unknown, and why a horse, mule, or even a dog is not to be found in the place.* In Peru and other countries similar remarks have been made.†

4. *Organic Impurities.*

Almost all waters contain more or less animal or vegetable matter, which is generally derived from the soil, and is in a state of solution or suspension. In marshes it may vary from

* "First Footsteps in East Africa," p. 23.

† "In several of the valleys on the road from the coast to the Sierra, and, above all, in the valley of Surco, there are certain springs, the water of which the Indians never drink. When a stranger unguardedly approaches one of these springs for the purpose of quenching his thirst, he is saluted by warning cries of *es agua de Verugu!* (It is Veruga water!) Even horses and mules are not suffered to refresh themselves at these springs, where the water is supposed to have the effect of producing a disorder called the *Verugas*. As the existence of this disease is not known in any other country, there appears ground for believing that it has its origin in certain local circumstances."—*Tschudi*. "Travels in Peru," p. 263.

See also *Smith*. "Peru as it is," p. 257.

10 to 100 grains per gallon, depending generally on the nature of the soil.

The flooding of rivers may cause waters to be impure, by carrying along decaying vegetable matter. If near the sea the water may be brackish and unhealthy, but vegetable matter has not then such a pernicious effect.

Animal matter may drain from various localities into streams, wells, tanks, ponds, or other sources from which animals are supplied, causing the water to become discoloured, to smell, and often to taste, badly. The shallow ponds, ditches, or pools in which animals are frequently obliged to seek for water, are very liable to contamination, both from their own excreta and surface impurities. Always stagnant, swarming with infusoriæ, and containing an immense amount of putridity and filth, especially in farm-yards and slovenly-kept pastures, they are yet regarded by many as convenient, which they may be, and healthy, which they cannot be, for it has been repeatedly observed that the flesh of such animals is believed to have a bad taste, and a peculiar odour. With milch cows, the latter has been particularly observed in the milk.

With an unaccountable depravity of taste, too, some animals seem to prefer the disgusting and unnatural concoction to water which is clear and limpid, probably from its containing, as a result of putrefaction, salts which render it sapid and agreeable.

There can be no doubt whatever that such a foul beverage predisposes to putrid diseases. Animals accustomed to it are often violently seized with dangerous symptoms, particularly in hot weather, and sometimes die. Even those animals which, by being compelled to use it, have resisted its ordinary pernicious effects, are not proof against it when the hot sun of July or August causes these ponds to be nearly dried up and more than usually putrid, and when these creatures have all the more need for large quantities of water. Dysentery, Diarrhœa, Anthracoid affections, and other mortal diseases, kill great numbers. In countries where good water is scarce, and what there is contains a large proportion of organic

matter in suspension, and probably fermenting, Carbuncular maladies reign enzoötically among animals, and are a perfect plague every year.

Water also contains, or serves as the vehicle for, the embryos or ova of several species of worms, or entozoa, which, being swallowed by animals, give rise to various disorders of a more or less serious character.

Leeches, in some countries, abound in streams and pools, and are a source of great annoyance and loss.

Many pathologists and physiologists have believed the causes of disease to exist in the water taken into the body. "The time is at hand," says Müller, "when the causes of disease shall not only be sought for in the air, in our method of living, &c., but in the incautious use of waters often abounding with innumerable animalcules."

THE INFLUENCE OF DWELLINGS.

Perhaps no subject is, as a rule, less regarded by the majority of those who have the care of the domesticated animals, than that of the influence stables or cow-houses may have on the health of their occupants. Persons who would readily ascribe the outbreak of a disease to something in the air, or any other occult influence, are very apt to overlook the oftentimes disgraceful and unnatural way in which they keep their four-footed servants; and that, in nine instances out of ten perhaps, their own neglect is the direct or indirect cause of illness among their stock, pecuniary loss—which is in the end national misfortune—and serious embarrassment.

In time, doubtless, the truths of physiology will be more widely accepted than at present, and then it will be discovered that a little care, a little more cleanliness, a little more breathing space and fresh pure air, and a little more daylight, would have rescued an immense amount of property from destruction, and averted much animal suffering.

1. *Ventilation.*

Ventilation is a subject pretty much ignored in very many cowsheds and stables; filth is supposed to be healthy

and business-like; darkness to be the natural condition of animals endowed with the keenest vision; and that an *olla podrida* of foul smells is the atmosphere in which they best thrive.

The importance of making animals comfortable in their habitations, giving them a sufficiency of air, keeping them clean and dry, allowing them freely of the light of day, and of maintaining the stable or cow-house in accordance with the aphorism that "the stable should smell no more of the horse than the apartment should of man," is one of pressing moment in every-day experience, but especially in the presence of an enzoötic or epizoötic disease. From the earliest times, it has been observed that close packing in faulty, filthy dwellings, with an imperfect supply of pure air, bad drainage, and deficient or unsuitable food, are the most fruitful causes, direct or indirect, of pestilence in man and beast.

It is not only necessary that houses for animals, if it be intended to keep them in health and fortify them against the inroads of epizoötic maladies, should be well built and roomy; but it is quite as essential that a superabundance of pure air be allowed to enter, and means of exit be afforded for that which has been rendered impure from respiration and other processes. From the great development of the breathing apparatus in the horse and ox, the activity of the cutaneous functions, and the gases and animal matters which are evolved in such quantity from their excreta, it must be obvious that an extensive degree of atmospherical contamination must be continually going on. And as all these emanations are prejudicial to vitality, when in a more or less concentrated state, so it is urgently necessary that they be removed as speedily as possible. Their continued action on the organism and derangement of its functions, must lead sooner or later to the evolution of diseased conditions, the interval depending upon the degree of concentration or activity of the blood-poisons which are present, and the constitutional stability of the animals so unfortunately situated.

2. *Cold and Damp Dwellings.*

Cold and damp habitations, when badly ventilated, are very unhealthy. The skin cannot perform its natural functions, and looks dry and chilly; and the lungs, hindered in their function of purifying the blood by the carbonic acid and other gases inhaled during every inspiration, are still further impeded in their office by the damp which enters them, and prevents their throwing off that which is a poison if retained.

In this way is the organism more or less profoundly altered, and rendered susceptible to the action of any occasional trifling cause which may arise; and thus are produced Catarrhs and bronchial affections; strumous diseases; pulmonary Phthisis, and other scrofulous affections; Rheumatism; and a host of serious maladies in ordinary times among the creatures so maltreated.

3. *Hot and Damp Dwellings.*

Hot and moist habitations, when animals are closely packed, and the air is but seldom renewed, are even more injurious. There is a sense of oppression, a feeling of uneasiness, perceived when one enters such a place from the fresh cool air without —a feeling not at all unlike that which one experiences during the sickly season at Hong Kong. It is a most unnatural condition for animals to be kept in, day after day, month after month, and year after year—animals designed by nature to roam on open plains and prairies, and seek their own shelter from the noonday sun, but always to enjoy the fresh, untainted atmosphere. In such places, if the experiment be tried, a burning lamp loses its brightness of flame, a cold sheet of metal becomes covered with moisture, clear lime-water is soon rendered muddy and opaque; the eyes smart, and if there is any tenderness about the throat, a tickling sensation is sure to be induced; while a combination of most unpleasant odours assails the olfactory organs.

The air, in fact, is largely contaminated by animal matter undergoing chemical change by putrefaction and decomposition, and no creature can remain for many days healthy in it.

Like cold, damp air, it retards exhalation from the lungs and skin. The deleterious effete matters, which should be thrown off by these important organs, must be removed from the system in some way or other, or the animal quickly dies. Therefore they are carried to other organs, and partially got rid of by the intestines and kidneys ; or, if a cow, in all likelihood by the udder in the process of milking, and consequently they exist in the milk ; for all these secretions and excretions are increased, and usually abundant, because of the suspended function of the skin and lungs. The creatures may become fat, but this is of a bad quality, and rather a symptom of disease. Their flesh is pale and flabby, and will not keep for so long a time as that of animals in sound health. The highly noxious matters they inhale enter the circulation by the lungs and stomach, and their blood is thus altered by septical agencies. Slowly, or perhaps quickly, poisoned, the lungs become disorganized from typhoid inflammation or tubercular or calcareous Phthisis ; diseases attributable to a semi-putrid state of the circulating fluid are rife, and the predisposition to become affected by other maladies is very great. Contagious diseases of various kinds, according to constitutional tendency, are generated and propagated in such an atmosphere, and organic effluvia or miasmata are given off profusely from the bodies of animals so maintained.

The matter which gives rise to these contagious diseases is, in all probability, partly gaseous or entirely molecular ; consisting of exceedingly minute organic particles or cells floating about the diseased creatures ; and as disease is but a rapid disintegration and transformation of tissue, and the products may thus be disseminated rapidly among closely agglomerated animals, and from dwelling to dwelling, we can scarcely wonder at the facility with which maladies of this class are spread. We have also an evidence of the presence of these aërial contaminations in close, hot stables, in which a number of animals are kept for some time, should one or more of them be sick or wounded and neglected, and the excrementitial matters allowed to decompose ; a malaria is engendered which cannot be ascribed to an alteration in the composition of the atmo-

sphere only; and we have produced an unhealthy state of the blood giving rise to putrid diseases, a tendency to excessive suppuration, corrosive exudations, phlebitis, purulent infection, and gangrene of the tissues in wounded animals, and in those which are already sick an aggravation of the maladies; and slow, uncertain convalescence.

The vitiated air of stables and cow-houses is thus one of the most potent agencies in impairing health and predisposing to or exciting disease, and the same may be said of overcrowded, badly-ventilated cattle-ships and steamers: all may become, and frequently are, veritable *foci* and nurseries of contagion.*

The examples of the benefits conferred by the admission of fresh, pure air, and the mischief arising from the retention of that which is hot and impure, are innumerable. In the French cavalry and artillery, the horses of which are kept in badly-ventilated stables, and have not sufficient space, Glanders and Farcy—contagious affections—destroy a large per-centage every year. In the mounted portions of our own army, these diseases (as well as others) were, it might be said, enzoötic in the different barracks, and productive of the most serious losses, before veterinary science had demonstrated the advantages to be derived from careful and rational hygiènic treatment; now it is rare to hear of a case among our troop horses. I have frequently had occasion to observe that when Influenza prevailed among horses kept in hot, ill-ventilated stables, army

* The evils of our home trade in cattle are most glaring, and reflect but little credit upon us. That between Ireland and England, for instance, is simply shocking, and its toleration for a week is indeed a matter of wonder and regret. From the report of a well-qualified observer, the cattle are frequently ill-treated, and often not fed or watered for days. "To these evils, those attending a sea journey must be added, and these I can from personal experience testify to be—A temperature of 80 degrees, an irritant atmosphere saturated with moisture, and loaded with gaseous products of animal excreta, especially ammonia, sulphuretted hydrogen, and carbonic acid, *and an odour that is perfectly sickening*." The animals kept in such a condition must be highly predisposed to receive contagion, and one sick animal may easily infect an entire cargo. Besides, these ships are perennial magazines of contagia.

horses have escaped, though quartered in barracks perhaps in the middle of the towns in which the malady was rife.

4. *Overcrowding.*

As already mentioned, the overcrowding of dwellings is particularly obnoxious, even when no disease is present among animals; and this, perhaps, not so much from the presence of various gases as from the organic matter thrown off; and, as has also been stated, there is every reason to believe that this is the frequent cause of such putrid diseases as most rapidly destroy life, more particularly in the case of animals adapted to live always in the open air. During the expedition to Quiberon, a storm overtook the fleet, and the horse transports, already imperfectly ventilated, were compelled to close the hatches over the unfortunate animals. After the storm many were found dead, and soon after all the others were attacked with Glanders and Farcy. During the American War of Independence, an English vessel containing a large number of sheep lost them all through overcrowding. But the horrors of overcrowding in ships are only too abundantly illustrated by what takes place in our cattle traffic.

An English farmer tried to feed his sheep on a variety of turnip. They became ill and died. A veterinary surgeon was sent for, and he recommended better ventilation of the building in which they were kept; this being carried out, no more perished, though fed on the same food.

Grognier has described a stable-fever of animals in France, analogous to the hospital and prison fever of man, and due, doubtless, to the same causes. He informs us that horses and cattle suffer more than man or carnivorous animals, when kept in a putrid atmosphere. They eat little, lose flesh, their chest becomes altered, and they are disposed to low, anthracoid, and typhoid fevers. But if the miasmata be very concentrated, they may cause sudden death, or induce epizoötic and contagious diseases.

Toggia informs us of a case in which forty-two cattle in a stable were infected by emanations from accumulating manure; and Youatt explicitly states that Ophthalmias, Coughs, Pneu-

monia, and Farcy prevail in such places, and that epizoötic maladies usually commence in them. This opinion I can fully corroborate, and, in addition, may assert that diseases of all kinds visit them most severely and frequently.

It must ever be borne in mind that fresh, pure air is at least of as much consequence as food and water to animals; they require a large and uninterrupted quantity, and it ought to be allowed them without stint or restriction.

5. *Absence of Daylight.*

The partial or total absence of daylight from the dwellings of animals cannot be much less injurious to them than it is to the human species. Its influence on important physiological processes is unequivocal in the animal and vegetable kingdoms; and though we cannot always trace disease directly to its exclusion, yet we may assume, from the results of experiments, and the frequency of grave diseases when light and other essentials are withheld, that its absence must predispose to abnormal states of organs, and greatly retard the performance of certain chemical and vital acts. The domesticated animals all enjoy the daylight and sunlight, and they are dull and pine away when they are banished into darkness.

INFLUENCE OF LABOUR AND FATIGUE.

The amount of labour or fatigue an animal is able to undergo is in a direct ratio to its condition. An animal in good health, properly fed and housed, will undergo an amount of toil proportionate to the strength of its organs. But when the stabling is neglected, or the food is not in quantity or quality sufficient to maintain the integrity and harmony of the vital acts, then disorder takes place from the impairment of some important function or functions. Long repose and a superabundance of food are prejudicial, more particularly if severe exertion suddenly follows.

The results of overwork and fatigue on insufficient or improper food are debility, an impoverished state of the blood, feebleness of organs, and emaciation. All this tends to the invasion of disease, and the severe enzoöties and epizoöties which frequently attack army horses on active service, or the

toiling horses of large cities when forage is scarce and bad, and the weather tempestuous, are thus in a great measure accounted for.

A certain amount of exertion is not only salutary, but absolutely essential to every creature; and, provided sufficient food and time are allowed to repair the loss of tissue, nothing tends so much to health. When these are not allowed, however, and the exertion is continued, the animal is predisposed to disease.

There are conditions or diseases, some of them contagious and very dangerous, which would appear to be induced by severe exertion or travelling. The contagious Foot-rot of sheep (the *piétin contagieux* or *Espagnol* of the French, the *Spanische klauenseuche* of the Germans) was unknown in France, Italy, and Germany before the introduction of Merino sheep from Spain; and, strange to say, it is not known in that country. We are, therefore, almost led to believe that the malady is produced by the fatigue attending their journeys to market, and the new influences to which they are subjected. Chabert, who was the first to describe the disease, in 1791, saw it on the banks of the Gironde, in Bas-Medoc, and in the Pyrenees, and says it is enzoötic there. Some time afterwards it was observed in Central France, in Piedmont, and in England; in Germany it has been known since 1815 or 1816.

Many veterinarians in Germany, and particularly in Saxony, believe that the Aphthous disease of cattle (Foot-and-mouth disease) is originally derived from pigs, and that it is developed in them during the long fatiguing journeys from Poland and Hungary into Germany, in the spring of every year. Certain it is that immense droves of pigs do so travel, and as they are frequently affected with this malady, they spread it as they journey along; but then they may have themselves received it in their native country, or during their progress.

Several of the most eminent Russian veterinarians have pointed out that the Rinderpest, or Cattle-plague, cannot be traced to its source, but is most frequently observed amongst the droves of cattle which, badly fed, and driven great distances, are sometimes almost decimated by the pest.

The Texan cattle-disease is only known, it appears, among travelling herds, and the fatigue they undergo may predispose them to the reception of the malignant influence which excites their peculiar contagious malady.

Travelled cattle and sheep have always been acknowledged to be the disseminators of disease in England and Scotland. Ulloa makes mention of a contagious disease which attacks the feet of mules during the lengthy and toilsome expeditions the droves of these creatures are submitted to in the different climates of South America. This disease is much dreaded, in consequence of the great losses it occasions; and it would appear to be similar in its character to what is vulgarly known as "grease" in this country, or "canker" of the foot.

As already observed, forced movements cause certain changes to take place in the function of organs, and in the composition of the various tissues; and it has frequently been suspected—nay, even asserted—that excitement or fatigue may give rise to anomalous secretions, and the formation of animal miasmata, or induce well-marked disease in the animals themselves.

Thus Laubender says: "The most intelligent butchers of Partenkirch and Gaernisch inform me that if an ox, during the heat of the summer, is compelled to make long journeys, and is killed immediately afterwards, the spleen will be found soft and black, the flesh a yellowish-red colour, the fat more fluid, and the gall-bladder very large and filled with thin green bile. They furnished me with the following proof: Two oxen were brought from a place six leagues distant; one was killed the following day, and the flesh, fat, spleen, and liver were the same as in an animal that had died from Anthrax. The other ox was killed eight days afterwards, and its viscera appeared healthy.*

* *Seuchen der Hausthiere*, vol. i. p. 889. Wrangell, when travelling in Siberia, writes: "On the 24th we climbed a lower range of hills, from the summit of which, to our great joy, we saw a wide valley, with numerous groups of trees; and by nightfall we reached a small lake at the foot of the hills. I now proposed to kill one of the horses, but the Irkuts said that, in the heated state of their blood, the use of their flesh as food would be certain to cause illness."

Butchers and epicures generally know that the flesh of animals, particu-

For a very long period it has been maintained that the forced marches of animals might cause the development of epizoötic and contagious maladies, and we have given instances, making particular reference to the Cattle-plague and the Texan disease. We have stated that the highest Russian authorities on the subject have asserted that the former malady is primarily developed in the migratory droves ;* and many German and French veterinarians profess the same opinion.† They quote repeated observations which would tend to prove that cattle which left Russia or Hungary in perfect health and good condition, were only attacked by the disease when they had been a long time on the way, or in Germany or France. Hurtrel d'Arboval declares "that a Hungarian ox, deprived of salt and heated by a forced journey, is perhaps, of all animals, most to be dreaded amongst its own species.‡ It is also believed by several good observers

larly hogs, which have been excited before death, has a deeper colour, and tastes more like game ; and Heusinger knew of amateurs who hunted the hog before slaughter, in order to give its tissues the flavour of wild boar. The ancient Germans used to hunt hogs to death, and the custom would appear to have been in vogue in England ; for there were very old laws in both these countries which prohibited the hunting (*hetzen* in German) of animals before slaughtering them, because it was known that their flesh was often rendered unhealthy thereby. It was even believed that venison from hunted deer acquired poisonous qualities, and often caused very serious accidents.

The flesh of animals in this condition is, however, often consumed. Burton, in Arabia, for instance, writes : "After the long and sultry afternoon, beasts of burden began to sink in considerable numbers. The fresh carcasses of asses, ponies, and camels dotted the wayside : those that had been allowed to die were abandoned to the foul carrion-birds, the Rakûam (vulture) and the yellow Ukab ; and all whose throats had been properly cut were surrounded by troops of Takruri pilgrims. These half-starved wretches cut steaks from the choice portions, and slung them over their shoulders till an opportunity of cooking might arrive."—*Pilgrimage to El. Medinah and Meccah*, vol. ii., p. 62.

* *Lepechin. Jessen* (Die Rinderpest, p. 47), and *Rawitsch.*

† Amongst others, Paulet, Huzard, and Hurtrel d'Arboval. Recent authorities differ from these, however, and assert that the malady cannot be so developed.

‡ Instructions, &c.

that, as in the Texan disease, such cattle have infected others, particularly French and German cattle, without themselves exhibiting any manifestations of disease. On this, Heusinger remarks that the occurrence is very singular, and tends to prove that these animals develop a miasma which does not act on themselves. "But," he adds, "I am inclined to think that in these cases the Hungarian cattle had the malady in a very slight degree, a circumstance of frequent occurrence, as every one knows.*

The disease in young horses known to grooms and farriers as "strangles"—a kind of pyogenic fever—more particularly manifests itself after they leave the locality in which they have been reared; this emigration, together with the fatigue, hardship, and change of diet, induces the disease, which recent authorities believe to be contagious.†

INDIVIDUAL PREDISPOSING CAUSES.

It will have been seen, from our hasty examination of the general predisposing causes of disease, how necessary it is that we should be prepared to recognize their importance, not only when a serious disease is threatening or has already attacked our animals, but at all times.

For these general predisposing causes, when they do not directly excite disease, yet impress upon it, and especially when it is of an enzoötic or epizoötic nature, a particular character, usually of the most serious description, and which is not met with in affections appearing sporadically, and due to the same exciting cause or causes; thus proving how potent they are in modifying the body and diminishing its power of resistance.

SPECIES OR RACES.

Species.—In connection with these wide-spread general predisposing influences, we must not overlook the predisposition of species or race, as well as of individuals. This predis-

* Pathologie Comparée.

† *Reynal.* Dictionnaire de Méd. Vétérinaire, vol. viii. p. 313.

position depends chiefly upon the temperament, constitution, sex, age, and hereditary causes. We will briefly glance at some of these; but before doing so it must be stated that, in consequence of their different organization, the various domesticated *species* have also a differential predisposition to contract particular maladies. Thus, ruminants are affected by diseases which are not seen in the equine or carnivorous animals; while these, again, have their peculiar affections. The Cattle-plague, for instance, is peculiar to the first, Glanders and Farcy to the second, and Rabies (primarily) to the third.

Race also modifies the predisposition, as we shall see hereafter; high-bred animals being more liable to nervous maladies than those which are common-bred; and cross-bred creatures showing less power of resistance to the attacks of disease than pure breeds. Röll has remarked that Hungarian horses offer a particular predisposition to Glanders and Farcy; the common-bred German horse is disposed to attacks of Vertigo; and the English horse to Colic. Steppe cattle introduce Cattle-plague into Western Europe, and resist the disease better than any other races. Hydrorachitis is peculiar to high-bred fine-woolled sheep; and the same authority states that pet-dogs are primarily more liable to Rabies than other breeds. But we shall again allude to this in succeeding sections.

TEMPERAMENT.

Temperament undoubtedly modifies the influence not only of predisposing, but also of exciting causes in animals. According to the predominance of one or other of the temperaments in certain species, breeds, or individuals, it is possible to prognosticate what maladies will be likely to affect them seriously or slightly, and what affections they will be exempted from. Not only this, but temperament will often enable us to give some explanation as to why animals of the same species, but belonging to a different breed, and reared in a different climate, have certain maladies which others have not, or only in a modified form.

The study of temperaments is necessary for the practitioner, not only in races, but in individuals; as by it he will be able

to judge of the nature, the gravity, probable complications, and other features in disease, and to frame his curative or preservative measures accordingly.

1. *Horse.*

Temperament in the *Horse*, which is essentially sanguine, is allied with certain maladies, especially those of an inflammatory character. But some horses of a particular form and disposition have an excessively nervous and irritable temperament, and these are liable to nervous disorders. Another kind of horse, from the coarseness of its general conformation, slow and heavy movements, a general torpidity of the nervous and arterial systems, and the predominance of the lymphatic system, might with propriety be designated as of a lymphatic temperament. This is particularly liable to maladies which are almost unknown in the other two, and generally suffers most severely in an epizoöty: its diseases being those of a typhoid nature, such as Glanders and Farcy, and Œdema and troublesome cutaneous affections. Specific diseases of the pituitary membrane, affections of the lungs, catarrhal and rheumatismal maladies, and functional or organic disease of the brain and spinal cord, are the typical maladies.

Taking into consideration, however, the great abuses to which the horse is exposed, the amount of labour it is called upon to perform from its earliest years, the exceptional hygiène to which it is submitted, and the markedly artificial state in which it is kept; as well as the fact of the unsound being kept for labour and often for breeding purposes, the feeble and defective all come within the category—taking all this into consideration, it must be confessed that few animals are so robust, or so well resist disease as the horse, and that it is but little liable to maladies of an epizoötic character. More particularly is this the case when the nervous and sanguine temperaments predominate.

2. *Mule and Ass.*

The *Mule* and *Ass*, though displaying less sensitiveness and mobility than the horse, yet seem to be gifted with such an amount of muscular energy and durability under very great

privations of every kind, that we recognize in them the sanguine-nervous temperament. They appear to have a great power of resisting the influences which induce enzoötic or epizoötic disease, and in this respect they come before the horse. Indeed they are so hardy, notwithstanding the bad treatment which they nearly always undergo, that they are rarely affected with any kind of general malady. They, nevertheless, offer a certain predisposition to diseases of the nervous system, such as Tetanus and Paralysis; while their inflammatory diseases are generally acute and run their course rapidly, being accompanied by marked nervous symptoms.

3. *Bovine Species.*

In the *Bovine* species, though we may at intervals find diverse temperaments, yet there can be no doubt that the lymphatic very largely predominates over all the others, and in organization it differs very widely from solipeds; this difference, together with temperament, impressing a peculiar character on its diseases.

The temperament of this species, however, is doubtless much influenced by climate, food, and the various objects man has in view in rearing it, whether it be for its flesh, milk, or labour; and this of course has a more notable effect on it than on any other species. Carefully bred, fed, and tended in every possible way, it cannot be wondered at that the lymphatic temperament should give place to that of a sanguine or nervous character, or a compound of these: a change which materially modifies the type of disease peculiar to bovines, and particularly diseases of the nervous or circulatory systems. Nevertheless, the prevailing temperament is essentially lymphatic.

In low, damp localities, or in marshy regions, where the air is cold and chilly, and the vegetation watery and poor, the cattle are large and bony; they have an unsightly outline, and their bodies are covered by a thick, shaggy skin, while the head is furnished with large horns, and the females give a scanty supply of milk—this is the real lymphatic type

Though pure native breeds are but little liable to disease,

there can be no doubt as to the very great susceptibility of cross and highly-bred cattle, their precocious development specially predisposing them. In consequence of the predominance of the digestive organs and the mode of alimentation, this apparatus is very liable to disorder; while, owing to the very large development of the lymphatic system, and the comparatively languid manner in which the circulatory function is carried on, the diseases affecting the solid tissues usually assume a chronic form. Those, however, which consist of an alteration in the mass of the blood sometimes proceed with extreme rapidity; probably because of the particular conformation of the respiratory and circulatory organs, with the excess of albumen and small proportion of red corpuscles in the blood. To sum up, it may be affirmed that in consequence of the predominance of the nutritive functions, there is in this species a special predisposition to disease of the digestive canal, the blood, and nutrition. Few of the diseases run a rapid course; the majority remain a longer time localized than in solipeds and carnivora, because of the less irritability of the nervous system.*

4. *Sheep.*

The *Sheep*, though a ruminant like the ox, is even more essentially lymphatic in temperament, and differs somewhat in organization, and particularly in the more aqueous character of its blood, the small proportion of red corpuscles in that fluid, and the facility with which the nervous system becomes deranged. By climate and culture this temperament may be much modified, and those temperaments which we see in other highly-bred animals will become as apparent in it, and alter in a greater or less degree the character of its maladies. In addition to the same morbid tendencies as the ox, there is a predisposition to diseases of a low cachectic type, such as "rot," and chronic diseases of the skin. The sheep is also somewhat remarkable for the entozoa, in the shape of worms of various kinds, which it affords development for. We may

* See Gellé's judicious remarks on this subject, in his "Pathologie Bovine." Also those of Flandrin ("Du Sel Marin") and Dick (Veterinarian, vol. xii. p. 382).

say of this creature, that it is the most delicate and susceptible of disease of all the domesticated animals.*

5. *Goat.*

The *Goat*, though also a ruminant, differs widely from the sheep in the nature of the food on which it lives, the much greater activity of its nervous and circulatory systems, its blood being as rich in solid elements as that of solipeds, a less developed lymphatic system, and altogether more energy, vivacity, robustness, and active habits, which but little predispose it to disease. Its hardiness is wonderful, and indeed proverbial.†

Like the sheep, however, its maladies are liable to be complicated with nervous disturbance, and some of its few maladies are even of a purely nervous character.

6. *Pig.*

The *Pig*, by its organization, being omnivorous, and temperament, which is sanguine, holds a middle place between the herbivora and carnivora, and considering the unnatural manner in which it is usually treated, is an animal but little disposed to contract disease. The apparatus of nutrition presents a special aptitude to become affected, and inflammation of the pharynx and larynx is not infrequent, and generally very fatal.

7. *Dog and Cat.*

The *Dog* and *Cat* are endowed with a sanguine-nervous temperament—the latter much more marked in the cat than the dog. Both are attacked by diseases in which nervous symptoms are most frequently predominant. In these animals Rabies is primarily developed.

CONSTITUTION.

The "constitution" is only the sum total of the integrity and energy of organs, and of the harmony and power which, all combined, they can bring to bear in sustaining vitality against the operation of external causes.

The different species of domesticated animals have different

* See Lefour, *Maladies Particulières aux Grand Ruminants.*

† See Palgrave, *Travels in Central and Eastern Arabia*, vol. ii. p. 132.

constitutions, which depend on their organization, temperament, and the strength of their vital energies. These constitutions are independent of the circumstances in which animals are placed, the mode of life to which they are subjected, and the care bestowed upon them; in fact, they are the special endowment of each species.

1. *Strong Constitution.*

A *strong* or *robust* constitution is the expression of a good temperament and perfect functional development: conditions which insure the body to a high degree against the production of disease. When the causes of disease cannot be successfully opposed, and sickness is the result, it is generally brief and acute, easily controlled, and followed by durable convalescence. Such constitutions best withstand active medical treatment.

2. *Weak Constitution.*

A *weak* constitution entails a predisposition to the action of morbid causes. There is a lack of energy, a want of reaction, and a tendency to succumb readily to the influences which produce disease. The diseases so produced pass readily into the typhoid state; their progress is often slow and obscure, and their termination unfavourable in the large majority of cases. Very young and very old animals are generally those possessing this constitution, but between the robust and feeble there may be many intermediate degrees of constitution.

The climate and breed, the situation in which they are reared, the kind of food they have obtained, and the nature of the labour or hardship to which they have been subjected, are all circumstances which modify the constitution of animals.

One thing to be noted in reference to this subject is, that an animal's constitution can rarely be ascertained from its external appearance, the innate vital power being often independent of that exhibited externally. The most powerful and healthy-looking creatures are not always those which are best able to resist disease or its exciting causes. On the

contrary, they are frequently the first to succumb; while those apparently the most delicate, often withstand the strongest assaults and rally quickest, proving that the power of vital resistance is independent of what appears to be the most perfect organization and most favourable temperament.

Among the domestic animals, the Ass, Mule, and Horse assuredly rank first as being endowed with the strongest constitution. Next to the equine species may be classed the Dromedary, Camel, and Goat, with perhaps the Dog, Cat, and Pig. After these the bovine species, and lowest of all, because the weakest in its resisting powers, is the Sheep.

In the same natural families we have marked gradations. Thus in the equine species, the Ass and Mule are hardier than the Horse, and in the bovine species the Buffalo is more vigorous than the Ox. And among the ovine species we find the greatest diversity in this way.

AGE AND SEX.

Age and sex oftentimes have some influence in predisposing to the advent of general diseases, and particularly the first of these.

1. *Youth.*

Immediately after birth, and for some weeks subsequent to that event, disease is most liable to occur, and this liability is great during the whole period of growth; in the adult period the predisposition is diminished, but it again increases with age. Each period has also its predisposition to special maladies. From birth to adult age, there is the greatest predisposition to diseases in general, a special tendency to disorders of the digestive organs, and the lymphatic and glandular systems, as well as those of nutrition and circulation. Youth is accompanied by extreme sensibility to the operation of external agencies, and the more important organs are readily irritated by general causes. A slight alteration in the nature or quality of the food immediately reacts upon the intestines; and changes in temperature are keenly felt, acting more particularly upon the lungs and other organs through the medium of the skin. In fact, so great is their susceptibility, that a large

class of diseases are peculiar to young animals, and cause much loss and suffering. Some enzoötic and epizoötic maladies specially affect animals which have not reached the adult stage of existence. We may instance the Dysentery and Aphthous disease of young creatures, Meseraic atrophy, and affections of the bones, disturbance due to parasites and entozoa, the "trembling disease," and "variola" of sheep, "strangles" in the horse, and the "distemper" of dogs.

2. *Adult Age.*

In adult age, when the body has attained its full development, and all the organs are in their greatest vigour, there is a diminished predisposition to disease. But the particular maladies of this period differ from those of the earlier or later stages, as do also some of those which appear in an epizoötic form. Acute diseases are generally more intense and serious at this period.

Towards old age, when the body begins to show evidences of decay, the disposition to take on epizoötic diseases is not much increased, though vitality is diminishing. Indeed, it would seem as if the decadence of life, and the loss of energy and impressionability, rendered the system less apt to contract these general maladies, and only to favour the advent of those peculiar to senility.

3. *Sex.*

The *sex* has some little influence in predisposing to general diseases; for it appears that in those countries where entire horses are employed, they are more susceptible to the effects of deleterious agencies than mares or geldings. As examples, I may give the epizoöty of Diabetes (Hydruria) which broke out at Paris, and was described by Moiroud, who says that "this epizoöty prevailed almost exclusively among entire horses; very rarely did it manifest itself in geldings, and I was unable to learn that any mares had been affected."* There are also the particular sexual maladies which are pecu-

* "Recueil de Méd. Vét.," vol. vii. p. 327.—Lassaigne found a large amount of acetic acid, partly in a free state, in the urine.

liar to each species, the most notable of which is the so-called "venereal disease" of horses that affects stallions and mares, but of course not geldings.

Milch cows, or those which are near, or have arrived at, their period of parturition, are more disposed to the reception of morbid influences than the male sex, and not unfrequently we have epizoöties of Abortion.

There does not appear to be any facts to bear out the idea that there exists a hereditary predisposition to enzoötic maladies, much less to those of an epizoötic character; though many instances might be adduced to show that particular races of animals are more susceptible to receive and develop the germs of specific diseases than others.

INFLUENCE OF RACES UPON EACH OTHER.

The facts relative to the reciprocal influence of animals of the same or different races upon each other in the production of disease, are not nearly so numerous, nor so well marked, as in the human species, possibly because of the smaller number of observers, and the fewer opportunities for observation. Nevertheless, some of those noted are particularly interesting.

It is known that until the introduction of certain species of creatures, or even varieties of the same genus, particular maladies were not observed among the indigenous races, and that as soon almost as these exotics appeared, even though no disease could be detected in them, diseases of a more or less deadly character—often epizoötic in their tendencies—have been developed. Some of these affections would, to all appearance, in time wholly or partially exterminate the native breeds, and leave the imported ones in possession of their country. I need only refer, as a likely example of this, to the Cattle-plague: a disease which, in the Steppe bovine race, sometimes appears in such a mild form as to be almost, if not quite, imperceptible, and seldom fatal; and yet the introduction of this race among the cattle of western countries, is attended with a fearful mortality. The Spanish Foot-rot of sheep is said to be unknown in Spain, and yet it is developed in France, Germany, and other countries by the introduction

of Merino sheep, acquires contagious properties, and proves a most formidable plague among the native flocks, being perpetuated among them by contagion alone.

But one of the most fatal maladies, perhaps, to which the ovine race in western countries is liable, is the "louping ill" of the Scotch shepherd, the *Maladie tremblante* of the French grazier, and the *Traberkrankheit* of the German farmer, which has only been developed and become hereditary since the importation of Merinos.* It was not known before that time, and I am not aware that it has been observed in Spain.

Animals coming from distant countries, with a predisposition to the maladies of these countries, may, when placed under peculiar influences in their new locality, develop these diseases, which might, until then, have been unknown there. Rabies, Glanders, and some other diseases may by this means be originated in a country, and domicile themselves there. Darwin remarks :—"I have heard it stated in Shropshire, that sheep which have been imported in vessels, although themselves in a healthy condition, if placed in the same fold with others, frequently produce sickness in the flock." May we not in this way explain the occurrence of the outbreak of Aphthous Fever in the vicinity of Melbourne, Australia, in 1872 ? The disease was first observed in a cow which had been imported from England many months previously.

Breeds.

The influence of different breeds on each other must not be lost sight of, when examining the predisposing or exciting causes of disease.

We know that certain defects, as well as a tendency to local or general affections, are hereditary, and, as a rule, not much influenced by crossing ; and that when a race introduces its distinctive characters and its special organic qualities, it will also introduce these.

French authors, among whom are Dupuy and Grognier, are unanimous in asserting that the disease termed "roaring"

* *Richthofen :* "Die Traberkrankheit," p. 19. *Richter :* "Gurlt and Hertwig's Magazin," vol. vii. p. 206.

(cornage) in the equine species, and which now generally affects horses in Normandy, was unknown there until the arrival of Danish stallions. Heusinger thinks it probable that the Distemper of dogs, which originated or was first observed in Peru, was produced there by the mixture of races. It was unknown in Europe, apparently, for some centuries after the discovery of the New World, and not until it was imported. The so-called "venereal disease" of horses is another malady which may have owed its development to the mixture of different breeds of these animals in Russia and elsewhere.

The influence of animals of one species on those of some others has long been remarked. It is said, for instance, that the hog is possessed of a morbid influence over all the domesticated animals which are near it; and many old laws are still in existence prohibiting these creatures being kept in towns. It is asserted that silkworms die when they are tended by negroes, probably owing to the deleterious action of their cutaneous secretions on these creatures; and some people state that crabs die if pigs pass under the carriage in which they are being conveyed.* Silkworm establishments have for ages been believed to be unhealthy for man and animals. At Milan, during the plague in 1488, 1523, and 1576, these industries were suppressed;† and Morici‡ goes so far as to assert that the silkworm-breeding establishments in Sicily may be enumerated as one of the causes of Malignant Intermittent Fever; while Husson declares that the eggs of fowls fed on the eggs and larvæ of the silkworm have a very bad taste.§

PATHOGENIC PREDISPOSITION.

Having thus briefly enumerated the principal, general, or individual predisposing causes of disease, and also pointed out some of the maladies to which they often directly give rise, it now only remains to be shown that the influence of one or

* *Heusinger:* Op. cit.

† *Ferrario:* "Statis. Med. di Milano," vol. ii. p. 267.

‡ *Morici:* "Sulle Febbria della Citta di Messina," page 7.

§ *Ramazzini:* "Krankheiten d. Künstler und Handwerker, übers. von Schlegel," page 187.

more of these causes, by inducing in a portion or the whole of the organism, a slight or profound alteration, originates what has been designated the *pathogenic predisposition* of animals. This state requires but an accidental or occasional circumstance to determine that departure from the healthy standard which we understand by the term "disease."

The pathogenic predisposition, it has been well said, is, with regard to disease, as the soil to the plant. To germinate, the seed requires a suitable soil, air, warmth, and humidity, before it can become developed into the plant; and so does disease generally demand the aid of heat, cold, damp, bad food, undue fatigue, foul air, or other pernicious agencies, to kindle and fan it into a flame.

APTITUDE.

In connection with the predisposing causes already described, we must not omit to notice that there is another condition of races, no less than of individuals, which, being closely allied to the pathogenic condition, and being a result of the predisposition, makes some more liable to develop particular diseases than others. This condition is termed *aptitude*, or *idiosyncrasy*.

In the practice of veterinary medicine, it is a matter of common observation that some animals betraying externally no manifestations of aptitude, yet need but the most trivial cause to produce a very serious, if not a fatal disease; while others, even apparently less favourably circumstanced, may be exposed to what we would deem most powerful influences without evincing much, if any vital disturbance.

Not only is this aptitude most remarkable in animals of the same species, but it is still more conspicuous in the domesticated animals belonging to various species. As before mentioned, among solipeds the horse is more apt to incur disease than the mule or ass; among bisulcates, the cow and sheep have an

aptitude considerably greater than the buffalo, the dromedary, the camel, or the goat.

This particular condition in animals of the same species, manifested when all are under the influence of the same predisposing and exciting causes, influences the advent of very different diseases among them, as well as tending at other times to produce the same kind of malady. Thus, with such diseases as Influenza, Dysentery, and affections of the digestive organs, we may have the same causes always producing the same diseases; while, again, exposure to cold damp air may induce different maladies in various individuals. Another peculiar feature in aptitude is, that some animals are disposed to be attacked by one particular disease from different exciting causes.

In races we may observe the same aptitude, which is no doubt due in great part, if not entirely, to climate, and the other predisposing causes already enumerated. According to Delafond, the bovine species raised in the marshes of Hungary, Italy, the Camargue, and La Vendée, have really an aptitude to become affected with the various forms of Anthrax, and the cattle bred in Southern Russia, known as the "Steppe cattle," appear to have an aptitude altogether special to contract, *spontaneously*, the Cattle-plague.

The same able observer put to the test of experiment this question of aptitude, which he viewed as an indispensable condition for the evolution of disease. Knowing that Rheumatism, Pneumonia, Bronchitis, Tetanus, and other diseases are often determined by sudden checks to the functions of the skin, and especially when animals have been undergoing active exertion until they perspire, and are then left to stand in the cold, he attempted to produce any or all of these diseases. Horses in apparent good health were galloped for hours, until their skin was streaming with perspiration, and were then exposed to currents of cold air. They shivered and trembled violently for about half an hour, an hour, or even several hours, and yet they remained free from disease.

1. *Effects of Newly Imported Diseases.*

It is important to note that, in proportion to a disease being strange to a country—that is, to a race or races of animals—so does the aptitude for its reception appear to be greater. The progeny of parents which have been affected exhibit a diminished receptivity or predisposition, and this becomes more marked with the duration of the disease among the various individuals of the race or races. Such has been the case with the Small-pox of man, and the first epizoöties of Rabies canina in Peru and the Antilles were extremely severe. When the canine Distemper first appeared in France, in 1763, it caused a very great mortality in that and other countries ;* and its ravages were no less severe when it broke out in Siberia in 1821. Witness also the first invasion of bovine contagions—Pleuro-pneumonia, in Britain, the Cape of Good Hope, Australia, New Zealand, and the United States of America ; and the irruption of Aphthous fever ("foot-and-mouth disease"), into France and Britain, in 1839. The Cattle-plague also furnishes us with an excellent, though terrible, example of a disease being comparatively mild in the country where it is always more or less prevalent, and ruinous in its effects when carried into regions which it has not visited for some years. Glossanthrax is another instance, and so is the Variola of sheep.

This almost universal aptitude of races to become affected with a newly-imported malady, applies more particularly to those diseases which have a contagium or viruliferous element for their maintenance and diffusion.†

* For a detailed description of these epizoöties, see my works on "Animal Plagues" (London, 1871), and "Rabies and Hydrophobia" (London, 1872).

† The fearful effects of newly-introduced contagious diseases have been as amply illustrated in the human species, as in the lower animals. For illustrations, see *Waitz* (Anthropologie der Naturalvölker), *Schoolcraft* (History of the Indian Tribes), *Washington Irving* (Astoria), *Wilkes* (United States Exploring Expedition), *Pöppig* (Reisen, &c.), *Humboldt* (Essai sur l'Histoire Nat. du Chili), *De Smet* (Missions de l'Oregon), *Walker* (Hist. of the Hebrides), *Darwin* (Voyages, &c.).

IMMUNITY.

THE opposite condition to aptitude, termed *immunity*, must also be kept in view when studying the nature of epizoötic and other diseases, as it explains many circumstances which would often be regarded as mysterious, and prove misleading. This condition might be defined as the power, temporary or permanent, with which certain races or individuals of a race or species are endowed, and which renders them capable of resisting those exciting causes that produce disease in the great majority of creatures exposed to them. For instance, among the domesticated animals there are some which are much less liable to be affected by general diseases than others; they possess a power of resistance that shields them from morbific influences. The buffalo, for example, will thrive and live to a good age in the midst of marshes and malaria; while the bovine and ovine species in these localities would be decimated. This is witnessed nearly every year in the marshes of Hungary and Tuscany, and in the Delta of the Nile. After the buffalo, the horse is perhaps best able to resist the malaria of marshes; but again, there are situations in which the horse suffers from destructive maladies, while the cow and sheep living under the same influences are unaffected by them. It is also noticeable, that while certain contagious enzoötic or epizoötic diseases commit great havoc among horses, cattle and sheep, submitted to apparently identical influences, remain in perfect health. The reverse of this also holds true, of course; for when we have cattle, sheep, and pigs, all suffering from such a disease as Aphthous fever, the equine species, except in rare instances, remains unaffected. At other times Cattle-plague is destroying the country, and yet no other animals suffer from it. And again, when this bovine scourge is very virulent, as in this country in 1865 and 1866, and in other countries at various times, more particularly in the Russian Steppes, when drought prevails, sheep, goats, and all other ruminants may be attacked by the contagion.

From these examples we are bound to infer that immunity

from certain maladies is natural to the various species of domestic animals: that is, certain general diseases are peculiar to particular species.

The breed, or race, the locality in which it has been raised, and its temperament and constitution, are all modifiers of this power of resistance to disease. If a number of animals belonging to the same species, but taken from different countries, or even districts, be all assembled in one place and exposed to the same exciting causes, we will, in all probability, find those from one region becoming affected before the others, and this without any assignable reason. Even with animals which have been living for a long time in the same country, we will frequently find a variety of one race suffer from an epizoötic disease, and others escape. Sometimes carriage and saddle horses in a town are attacked, and draught or country horses are not at all affected; while at another time the latter will be almost entirely involved. And in the same family or genus there is frequently the greatest difference as to immunity. The ass and mule, for instance, are but rarely affected by the epizoötic diseases from which the horse suffers.

And so it is with other animals.* Sir Stamford Raffles, speaking of the animals of Java, writes: "Buffaloes, more than other domestic animals, are subject to an epidemic

* The same strange immunity is observed with regard to animal and vegetable poisons. Tennent (Ceylon, vol. i. p. 147) alludes to the Mongoos of India and Ceylon, being proof against the bite of a poisonous snake. The hornbill feeds with impunity on the deadly fruit of strychnos; the milky juice of some species of euphorbia, which is harmless to oxen, is invariably fatal to the zebra; and the tsetse fly, the pest of South Africa, the bite of which is mortal to the ox, dog, and horse, is harmless to man and the untamed creatures of the forest. Rabbits can eat belladonna, stramonium, and henbane with impunity; pigeons can revel on the poppy, and goats can enjoy masticating a quantity of tobacco which would produce serious effects on larger animals.

"Pigs in America are said to destroy and eat the rattle-snakes with impunity; but they suffer much from the bite of the scorpion and from caterpillars."—*Collaine*: "Moyens de Conserver la Santé de Cochons."

Sheep, on the contrary, eat the poisonous tarantula, and other creatures likewise eat venomous spiders with impunity. The bite of the rattlesnake is more deadly for the horse than the dog, and cats do not suffer much from the bite of vipers.

disease, the symptoms and nature of which have not been hitherto carefully noted, or satisfactorily explained. It prevails throughout the whole island, and generally reappears after an interval of three, four, or five years; it makes great ravages in the stock of the peasantry, and is checked in its progress by no remedies which have hitherto been discovered or applied; it is of an infectious nature, and excites great alarm when it appears; it bears different names in different parts of the island. *As the bull and cow are not liable to this disease*, and as, in addition to this advantage, they are less expensive in their original purchase, they are preferred by many of the natives."*

The immunity of individuals is no less remarkable, and often leads those who are ignorant of the subject to doubt the contagious properties of different epizoötic diseases, when, this resisting power being manifested, some animals may escape. True, this individual exemption is difficult to appreciate; for it is often independent of breed, constitution, or temperament, and would seem to be an innate vital dispensation sufficiently active to overcome the invasion or evolution of disease.

We know that in certain soils particular seeds will not germinate, or if they do so it will be feebly; that in other soils they will flourish; that when certain animal parasites are transferred from the bodies of a particular species of creature to those of other individuals of the same species, they will either die, or produce but a slight irritation before they disappear altogether.

We also know, from experience, that a virus, the most active possible, deposited in textures exceedingly sensitive and absorbent, is sometimes impotent to develop the specific malady which produced it in certain individuals, no matter for how long a period it may be permitted to remain in operation. At the same time, other individuals, in appearance far more likely to offer resistance to its action, will, through the most trifling influence, or a virus the most impure and diluted, yield at once to the morbigenous agent.

* "History of Java," vol. i. p. 112.

With animals exposed to very unfavourable predisposing causes, of course the chances of immunity are diminished, because the vital resistance on which it depends is weakened or in abeyance.

There is nothing so curious and remarkable as this total exemption from the operation of morbid influences sometimes; and there is no more apparent reason to account for its eccentric developments, than there is to explain the different forms of disease which will spring up from the same accidental cause. Sometimes, for instance, owing to this peculiar and inexplicable condition of the organism, the immunity may be said to be perfect, and an animal will resist repeatedly the determining causes of certain maladies. Thus, a certain dog at the Alfort Veterinary School could not be made to receive the poison of Rabies, though repeatedly and carefully inoculated; and knackers' horses often enjoy a wonderful immunity from Glanders. But no sooner are other causes brought to bear, than the same animals which successfully resisted one kind of influence show themselves readily accessible to their operation.

An animal may be inoculated with a virus from perhaps two or three different sources at various times, and without the slightest result; but the first inoculation with another kind may be at once effective.

Another feature in this immunity is, that an animal may be thoroughly proof against the reception of a certain virus at one time, and extremely susceptible to its introduction at another, though we can perceive no difference in its health or condition. When a number of animals, says Delafond, of the same species, and in the same external circumstances, are submitted to the same causes, direct or indirect, the immunity may be complete as regards some, and incomplete as regards others, according to the individual organic capacities which animals possess. Thus, among one hundred sheep of the same breed and age, placed in the same hygiènic conditions, and, in fact, all subjected alike to the same external influences, if all are inoculated with the virus oft he ovine Small-pox—a very contagious disease—ten may be found to entirely resist

the contagion and prove refractory to the influence of the virus, sixty may only show some small pustules in the vicinity of each inoculation wound, twenty-five will be attacked by a mild form of the disease, and five will have it in all its malignity and perish. These numbers are of course only approximate, being liable to variation, but they nevertheless give a good idea of what usually takes place in these inoculations.

As has been remarked, this immunity is very likely to mislead people who have not studied disease, and is generally made a strong point in the arguments of those men who, denying the importance and value of the most positive evidence, maintain their disbelief in the existence of contagious maladies. The experience of the last forty years in this country has testified to the truth of this statement, and afforded many curious illustrations in the case of the contagious bovine Pleuro-pneumonia, Aphthous fever, and the Cattle-plague. It can scarcely be forgotten how many people were for a short time deceived during the attempts to prevent the last-named disease by vaccination in 1866, when it was stated that a previous attack of Cow-pox, or the performance of this operation, were affording exemption from the frightful malady ; whereas, it was merely a temporary and brief immunity that had preserved a few animals, whose subsequent infection and death quickly dispelled the illusion.

It is well known, however, that certain virulent maladies which have been transmitted, and have passed through all their morbid phases, *as a rule*, give to the individuals of the same, and sometimes of a different species, a temporary or permament immunity from a second attack. Thus the Cow and Sheep-pox, transmitted in a natural manner, generally secure complete and lasting immunity ; though, of course, exceptions to this rule are observed. The Cattle-plague is said to be very enduring in its exemption after the first attack ; so is the "horse-sickness" of South Africa, and the contagious Pleuro-pneumonia of cattle. "Distemper" in the dog, and the "strangles" of the horse, are also supposed to belong to this class, though instances of second, and even several, attacks

are not remarkably rare.* Other epizoötic diseases, such as Aphthous fever, do not confer permanent immunity.

The attention of several scientific veterinarians and others has been for some time much devoted to this subject, and hopes—not without some prospect of realization, from the results already obtained—have been held out that some day a discovery will be made by which an artificial immunity from the attacks of virulent disorders will be conferred on animals.

OCCASIONAL CAUSES.

So long as the animal body is in a state of preparation, or is *predisposed*, for the reception of disease, the causes which have so modified it may be said to be remote influences; and there is now only required the spark to ignite the morbid readiness of the constitution to develop symptoms of disturbance. This exciting agent or influence is named the *occasional* or *accidental* cause.

We have already seen that the predisposing agent or agencies may sometimes become the occasional exciters, and induce active disease when animals have been submitted to their effects time after time, or continuously; sometimes without any appreciable change until after a variable period, and at other times suddenly. But this is not always the case, and often great care is necessary to distinguish between the preparatory and the exciting agencies; for upon our knowledge of these will, in a great measure, depend our preventive measures and our ideas as to the nature of the disease.

For example—to take a sporadic case—we have seen a small wound caused by a sharp stone, the prick of a spur, or the scratch of a lancet, give rise to "farcy" in horses which

* These contagious diseases of animals resemble some of those occurring in the human species, which, *as a rule*, only attack a person once in a lifetime—such as Scarlatina, Small-pox, Measles, and Whooping-cough. Instances of second attacks of these are recorded, but they are rare.

were predisposed to the evolution of the disease; and had we looked upon the determining cause—the injury—as the sole agency at work in producing this serious malady, we should have made a great mistake; and a case of disease which might be curable by local and constitutional remedies, and the removal of the predisposing causes, would be lost if local treatment only were adopted.

We may then understand by the term "occasional causes," those influences which produce the appearance of disease in various organs rendered susceptible to their action. These diseases may differ as to their nature, and also their seat. Thus, it is recognized that exposure to currents of cold air, or the action of cold in other ways, may induce organic disturbances, but not always of the same kind; a number of animals will have Catarrh, others Pleurisy and Pneumonia, others Inflammation of the Intestines, and so on, according to their individual predisposition; while others in health may be exposed to this cause with impunity.

Among other considerations, we are induced to believe that, in general, all the causes which react on the body so as to invite disease, become occasional exciting or direct causes when they, as it were by accident, originate the malady for which they had predisposed it. According to this view, we should give the first place to atmospherical vicissitudes—or rather, intemperate seasons—in the production of certain sporadic or epizoötic diseases. These may so affect the health of large masses of animals, as to render the action of any specific agency more potent than at other times; or by extreme irregularity of temperature, humidity, dryness, or other conditions, themselves prove most active in generating wide-spread maladies among the lower animals.

In the human species, these physical causes have for centuries been recognized as the generators of disease; and if in man, who is able, by his superior intelligence, to protect himself from their action to a great extent, they induce disturbance of health, how much more powerful must they be in their action on those creatures which are unable to provide

themselves with a defence, and are yet rendered by domestication as sensible to their operation as man himself.

Allusion has already been made to these as predisposing causes; but we must not forget that when the atmosphere is much disturbed, or the seasons are *unseasonable*, the vegetable kingdom is as likely to suffer, and become diseased or deteriorated; and this, in conjunction with other morbific influences—as inundations, droughts, &c.—will produce disease.

It is by a knowledge of the manner in which these causes act in producing maladies that, according to Delafond, we can discover the reason why excessive fatigue, high atmospheric temperature, bad food and water, should develop Cattle-plague in cattle from Southern Russia, which are already predisposed to it, when they follow armies, or are driven great distances to fairs; while the same causes, acting on other races of cattle, would only produce Dysenteric or Carbuncular diseases.*

As a general rule, the diseases arising from these occasional causes are very serious and difficult to cure; and when convalescence is once established it is long, and requires more

* The history of this malady, so far as the Steppe cattle are concerned, would appear to confirm the existence of this strange idiosyncrasy in these bluish-gray oxen. Every year, hundreds of thousands of these animals are driven into Poland, the Austrian provinces, and Bohemia, from Southern Russia; and more than 100,000 of them, during the greater part of the year, drag heavily-laden unwieldy carts filled with salt along the unmade roads leading to the Crimea, Bessarabia, Podolia, Volhynia, and other north-western provinces, taking back corn to Odessa. All this causes intense fatigue, and there is, besides, the hunger, thirst, and exposure to inclement weather; so that it would appear that their peculiar malady is developed in them solely in consequence of their special aptitude, and the atmospherical and other causes encountered. The fatigue, privations, and vicissitudes of war produce the same result. Taking these facts into consideration, might we not fairly believe that the same class of causes were at work among the shipload of Russian cattle brought direct from Russia to England in 1865, and which were exposed to the heat, confinement, foul air in transit, and the cruel exhaustion consequent on their journey to London, and sojourn in the market there, thus developing the terrible outbreak of Cattle-plague which wrought such destruction? If this mode of origin of the disease be adopted, it will explain many epizoöties of this malady whose appearance is involved in mystery.

patience on the part of the medical attendant than those which arise from some determinate cause, such as would produce a sporadic malady.

SPECIFIC CAUSES.

ATMOSPHERICAL MIASMATA.

THE occasional causes just referred to are those which it is generally agreed man has the power—knowing their mode of action, and they being nearly always palpable agencies—of neutralizing their effects.

But there are other causes to which the name of *specific* has been given. These are, with exceptions which will be mentioned presently, of a more or less obscure nature; and in whatever way they may operate, and independent of the previous modifications animals have undergone, they are supposed always to produce the same disease. For the weather does not always induce enzoötic or epizoötic disease; meteors and portents in the air have long been given up as productive of evil consequences to health; the most irregular and tempestuous seasons are frequently attended by little, if any, harm to the domesticated animals; and the most favourable weather, apparently, may, on the other hand, see them dying by thousands from causes which seem to be inappreciable. Against the effects of some of these the utmost efforts of human skill are sometimes exerted in vain, and their investigation is surrounded with formidable obstacles which man is only learning slowly to overcome.

The diseases which these causes determine are special in their character and type; one class is said to be due to *atmospheric miasmata* and *marsh effluvia*; another to the miasmata given off by creatures in certain conditions; while another, the product of diseased animals, and independent or not of external influences, is due to the transmission of a *viruliferous principle* or *contagium* from the sick to the healthy.

The existence of an "atmospheric miasma (*μίασμα*, from *μιαίνω*, to pollute") is certainly hypothetical, but observation endows it with much—nay, the greatest probability. True, we have no leading facts to guide us in forming an opinion as to the nature of this miasma; we have not been able to isolate, in a sufficiently satisfactory manner, any heterogeneous principle to which might be really ascribed the evolution of any particular disease. We are, therefore, quite ignorant as to the character of the pestilence-breeding elements, and as to the how, where, and when they are created. We can only speculate as to their presence, and base our speculations on the observations we may be able to make on the phenomena attending their operation on living creatures. At the same time, the admission of such atmospherical miasmatic influences goes far to clear up a number of the perplexing questions which meet us on the threshold of our inquiry into the origin and diffusion of many epizoötic visitations; as some of the chief characteristics of these maladies can only be explained by a reference to such aërial agencies. From the presence of such a pollution in the air which creatures breathe, and which surrounds their bodies, we can understand why an enzoötic disease may have its boundaries swept away, and itself become a far-desolating epizoöty.

But it may be asked, "Do the winds carry these infecting elements for hundreds of miles without altering them or diminishing their potency? and do epizoötic diseases follow the track of the prevailing winds?" These questions might seem unanswerable, and likely to disturb the stability of such an hypothesis as the one we are now considering; for if all the epizoötic diseases sprang from a centre, and the morbid elements which occasioned them were diffused by aërial currents, we must look for such maladies wherever these have travelled. But they are not so spread; on the contrary, they have a pretty regular geographical movement or distribution, which would appear to be uninfluenced by the winds or other palpable physical agencies. It has been remarked that the great epizoöties of Glossanthrax have had their commencement in the south, and have extended towards the north;

while the epizoöties of Aphthous fever have oftentimes pursued an opposite course; springing from the north, they have become diffused towards the south, and, what is more remarkable, they have nearly all of them remained stationary for two or three years, as remarked by Verheyen, without being influenced to any very appreciable degree by the seasons, temperature, or atmospherical perturbations. Their state of fixity for a long time, and then their erratic diffusion, can only be reasonably accounted for, according to some authorities, by supposing that the miasmatic principles, whatever they may be, originate in the atmosphere, and become multiplied there; their multiplication, however, depending on circumstances more or less favourable. When these accessory circumstances—which again may depend upon the existence of many collateral phenomena—are propitious, and the infecting principle has attained sufficient power, it may then become propagated and diffused by the contact of masses of air with that already polluted.

Between enzoötic and epizoötic diseases of a certain class, there would seem, then, theoretically, to be this difference: that the first are due, or allied to, telluric influences, while the second depend upon the presence of an atmospheric miasma. Practically, however, these distinctions are not always easily made; for we confess to know nothing of the circumstances which modify or exalt the action of the primary cause of epizoöties; nor can we explain why they should sometimes appear over vast tracts of the earth's surface, and at other times be limited to a comparatively small area; or why some of them should, at one visitation, attack a number of species of animals, and at another only one or two, and even remain dormant, as it were. We may instance "influenza," or even "aphthous fever." The invasions of the last-named malady are particularly interesting in this respect, if we examine them for this century only. In 1809, for example, it traversed Germany, entered Switzerland, and penetrated France, where it remained until 1812; during this period it attacked the herds of Italy and Holland. In 1819 it made a similar irruption. In 1823 it appeared in Alsace, Switzerland, and Italy.

In 1846, it prevailed from the Caspian to the Adriatic Sea, and in 1855 it spread over Germany, Switzerland, Italy, France and Belgium, and in 1857 it showed itself in England, where it only remained for a short period. The outbreak which occurred in 1837, and lasted until 1842—during which period it appeared in this country for the first time—manifested itself in every part of Europe, from the frontiers of Bohemia to England, Ireland, and Scotland, and affected several species of animals; in 1857 it re-appeared, but lasted for only a brief space. In Belgium it remained for six months, was only apparent in a few districts, and confined itself to isolated herds of cattle. In 1862, it again manifested itself extensively over Germany and France; and in 1869, beginning at the Bohemian frontier, it spread into East Germany, passed rapidly into Belgium, Holland, and England, and afterwards into Bavaria, Wurtemberg, Switzerland, and France.

The last serious irruption—that which occurred in 1872, and prevailed in Switzerland, Southern Germany, and France, and extended to Holland, Belgium, and England—also remained for some time, and was most severe in 1873; it attacked several kinds of animals.

Ophthalmia has been frequently observed to appear in an epizoötic form, and affect man and the lower creatures. Intermittent fever has also been reported as prevailing among people and horses at the same time; and the terrible "Iaswa" of Siberia usually includes mankind, when it appears among several species of domesticated animals. Cholera, in some of its visitations, has been reported as showing itself in various species besides man (particularly in the epidemy of 1828-33); while at other times only the human species has been affected.

1. *Nature of Miasmatic Diseases.*

From the mode of their extension, and the way in which we notice animals affected during the course of epizoötic diseases, we are led to infer that the deleterious principles which pollute the air give rise to two classes of diseases very different from each other sometimes, and at others apparently

identical. Those belonging to the first class, which we may term the simply "miasmatic" class, only become extended by the diffusion of the miasmata which originally caused them. The second class, which may be named the "miasmatico-contagious" class, are not only spread by the influence of the primary cause, but also through the medium of a virulent element which is developed in the sick creatures, and is as potent in producing the same disease in animals previously healthy—though predisposed—as the atmospherical agent itself might be. Experiment, and especially the inoculation test which we can so readily apply in the case of animals, puts the existence of this contagious principle beyond a doubt in the great majority of cases; but there are some epizoöties which at one time are said to be contagious, and at another are believed not to be so. The "influenza" of the horse—and also of man—has been cited as an example; but as it is not inoculable, it is really difficult to decide positively whether it (and some other maladies of a similar character) is really contagious at all times.

An examination of the facts accumulated to decide the question, would lead to the belief that between the aërial miasma and the contagious principle, the line of demarcation is not particularly well defined. Animals may become the medium for conveying miasmata, just as they may have concealed in them or about them a virulent element; and in this way they may infect localities which were free from the particular disease until their arrival; while frequently enough, if not always, miasmatic diseases follow the tracks of commerce.

Thus may a disease of a purely contagious nature, and another purely miasmatic, be propagated in such a way as to leave a doubt whether it belongs to one or the other class, when experiment fails to decide the question.

A difference of locality may also influence the character of a miasmatic malady. In the Russian Steppes (and in several countries of the East, as will be shown) the Cattle-plague is miasmatico-contagious, yet in Western Europe it is purely contagious; in Central Europe the contagious Pleuro-pneumonia of cattle is asserted to be the same, but it owes its ex-

tension solely to contagion elsewhere. Rabies in the dog, from its irregular appearance, and its development as an epizoöty only at long intervals, has led many authorities to consider it as miasmatico-contagious in its origin; while others, again, believe it to be spread and maintained solely through the medium of a contagium. Several forms of Anthrax undoubtedly belong to the miasmatico-contagious class.*

When the miasmatic disease elaborates a contagious element, two causes then operate in its extension; but they are identical, in so far as that they can be mutually regenerated, and in their results they scarcely offer any difference. Verheyen cites the remarkable instance of the Small-pox plague which lasted from 1697 to 1698, and indiscriminately attacked the human species, land and water fowl, and pigs and sheep.† Now, it is well known that the Small-pox of man and the sheep, or of the sheep and pig, are not mutually transmissible (though exceptions to this rule are recorded); so that the extension of this epidemy and epizoöty cannot be attributed to mere contagious propagation; though of course it may have been so among animals of the same species. As a proof of this, the same authority mentions the case of Belgium, which was then visited for the first time by sheep Small-pox, and since that period has entirely escaped, unless we except a slight visitation of the disease in a single flock, in the province of Antwerp, in 1823.

If, in this general outbreak, the virulent agent had been endowed with a power equal to that of the atmospherical miasma, it might be expected that similar effects would follow similar causes, and that further proof of its contagious character would have been produced; but it was not, and this shows that a practical distinction between contagion and what we

* This class also exists in the diseases of mankind. The Eastern Plague is miasmatico-contagious in Egypt, but in Europe it is only known as a contagious malady. Cholera in India is miasmatic and contagious, while in this part of the world it is regarded, I believe, as essentially contagious. It is the same with Yellow fever.

† See "Animal Plagues," page 168.

may term infection—even in those maladies which we have designated contagious and miasmatic—is sometimes not easily made.

But in those diseases which are exclusively contagious—those which, like the Cattle-plague, only exist by the elaboration and diffusion of a virus—such a distinction is possible and easy. But we will notice these contagious maladies hereafter; in the meantime we have to glance at other causes of an unknown nature which produce disease.

It would seem, as we have already stated, that certain principles mixed accidentally with the air may alter or affect it in such a way as to cause the production of enzoötic or epizoötic diseases of various kinds. These principles are generally referred to as being derived from the organic world, and it would appear that during the decomposition of animal and vegetable matter particular gaseous substances may be evolved, or organic molecules may be developed, which, gaining access to the body, occasion disease. Sometimes they are the result of emanations given off from stagnant water in which animal or vegetable substances are putrefying; at other times they would seem to be some unknown agents generated in the earth or the air, and possessing the power, under certain conditions, of maintaining and spreading themselves over a large surface of the globe (the *Wander-miasma* of the Germans) for a brief or indefinite period; or they may be derived from the bodies of living animals themselves. In the latter instance, if the bodies of these creatures are diseased, they exhale morbid products which, diffusing themselves in the atmosphere, and acting on healthy animals, induce in them a similar affection. This mode of extension is peculiar to contagious diseases.

Deleterious principles may be generated and spread when animals are kept in a filthy state or overcrowded, and the air around them poisoned by exhalations from their bodies and excreta; so that this atmosphere may cause a disease common to all who inspire it. This is so notorious that it would appear to be a law of nature.

The diseases due to simple miasmata, as differing from those of a contagious character, are a very important class, but the

difficulty of distinguishing between them will induce us to consider both as due to the same causes. If we admit that certain enzoötic and epizoötic diseases are produced by particles of organic matter which, obtaining access to the body, infect it in a peculiar manner, then we may agree with the definition of infection generally accepted, as to the mode by which a focus of corruption, perceptible or not to our senses, gives to the individuals submitted to its influence the faculty of contracting a malady of a particular kind when they are predisposed. Many local and general maladies are supposed to occur in this manner from infecting agents derived from the earth and the air.

2. *Characteristics of the Malarial Infection.*

Infection of this kind would appear to possess the following characters: the power to attack a great number of animals at one time, or within a short interval, and without their having any communication with each other—either those in health or with those affected by the disease which has arisen among them; to be amenable to the direct influence of the climate or season, heat, humidity, and other analogous circumstances, in such a way as to spread farther if the temperature be elevated and the air damp, or lose its power partially or totally when a decrease in humidity and heat takes place; and to disappear more or less in proportion as we are successful in removing the causes on which the infectious agents depend for their maintenance, without its being necessary to separate the diseased from the healthy animals. In the latter particular we perceive a wide difference between this class of maladies and those to which contagion is added. The miasmatico-contagious diseases, though primarily induced by infection of this kind, frequently extend by contagion alone—for example, the Foot-and-mouth disease is supposed to be primarily developed by a miasma in certain regions.

Foderé, aware of this feature, has defined the maladies which arise from local agencies in the following terms: These diseases, after being developed sporadically, and extending themselves in an epidemic form, frequently enough become

contagious, some more, others less so, when they have attained a high degree of intensity in consequence of great changes produced in the bodies of the diseased ; and also of a pathological perturbation which develops elements less simple than the miasma that generated the primary disease. These elements differ greatly from the original miasma, and consequently have special qualities, by which they nevertheless produce an identical malady, but one whose propagation is no longer influenced by the temperature and seasons, like the original generators.

EARTH OR MARSH EFFLUVIA.

The sources of the primary infecting agents are to be found, as has been stated, in the putrefaction of vegetable or animal matter, or a compound of these. In marshy situations we have an instance of malaria or effluvia producing maladies of a particular kind, and in a special manner.

1. *Nature of Malarial Poison.*

It is well known that some ponds, lakes, marshes, fens, districts where the subsoil is argillaceous and retains the moisture on its surface, and those places which are occasionally submerged by salt and fresh water, are generally the sources of malaria. Besides these, the tracts of country—be they clays, dense marls, or other alluvial soils—which have been temporarily flooded by rivers, or the deltas formed by the embouchures of certain water-courses—such as that of the Nile in Egypt, the Danube, Dnieper, Don, and Volga in Southern Russia, the Rhône in the South of France, as well as the country along the track of such rivers as the Ganges, Indus, Brahmapootra, Nerbudda, and Krishna in India, and the Niger, Gambia, and Senegal in Africa—are noted for their mephitic atmosphere.

Much vegetable matter is mixed up in these soils : for instance, the Tuscan Maremma contain 30 per cent. of organic matter ; and at certain seasons the water and air are very impure. In marshes, the vegetation is rich and abundant, and stagnant water swarms with infusoriæ and larvæ of various

creatures, while all kinds of aquatic animals live and die in these places. From the remains of all these, a thick layer is formed which is largely made up of organic matter; and when the waters are frozen, or during the rainy or flooding season, and this stratum is well covered, such localities are only unhealthy because of their humidity. During the summer heats, however, when evaporation takes place, a portion or the whole of the water disappears, putrefaction goes on rapidly under the influence of the air, warmth, and moisture, and various products of this process are evolved. Usually there is an excess of carbonic acid, and a variable amount of sulphuretted and carburetted hydrogen, while free ammonia and hydrogen, and phosphoretted hydrogen, are often present. There is also a considerable quantity of organic matter discovered in the air over marshes; this air has been repeatedly examined, and found to possess tolerably uniform characters. For example, it blackens sulphuric acid when allowed to pass through it, and it gives a red colour to nitrate of silver; its odour is marshy, and it has a flocculent appearance. A strange feature in its character is that ozone does not destroy the organic matter when that gas is passed through a solution of it: a proof of its possessing conservative powers of an extraordinary kind.

In addition to this peculiar ingredient in the air of marshes, various vegetable and animal bodies of minute size, the *débris* and pollen of plants, insects, and infusoriæ—microphytes and micrococci—float in it, being carried upward by the power of evaporation: a power all the stronger the more intense the heat. The researches of Gigot-Suard and Gratiolet, and more recently those of Becchi in the Pontine marshes, have demonstrated that the minute cryptogamic bodies already mentioned as found in the atmosphere, are in extraordinary abundance in such localities.

We can readily understand that these matters, though suspended in the atmosphere, yet being specifically heavier than that medium, are only carried to a certain height, depending on the temperature. It is generally understood that an elevation of 1500 or 1600 feet above marshes, preserves animals from their influence; but this differs very considerably

in different regions. At Rome, for instance, it is sometimes found that an elevation of one or two storeys will attenuate, or preserve from, the ill effects of malaria, while at Vera Cruz safety is not assured at less than 2000 feet above the malarial region. Reynal has frequently observed that in France a height of sixty or eighty feet above a marsh is sufficient to insure animals against danger from pernicious effluvia. Often an inconsiderable obstacle will prevent the diffusion of miasmata; a ravine, wall, wood, or ridge of trees interposed between a marsh, and a pasture or dwelling, will frequently afford protection in malarious districts.

The organic matters or effluvia of these localities are not readily oxidized or altered, for they may be carried long distances by warm currents of air without losing their virulency, when they do not pass over the surface of water. This distance has been estimated at from 200 yards to a mile; but the horizontal extension depends on locality, and on the mountains, valleys, rivers, woods, and winds they may meet.*

Puvis has calculated that in those localities where marshes form a two-hundredth portion of the total area, the effluvia will extend over a thirteenth of their surface; and in the Charente-Inférieure, according to Lefèvre, the marshes of Brouage send their effluvia to Rochefort, distant about six kilomètres (four and a half miles), though other authorities declare that they travel seven to eight kilomètres.

Rapid currents of air, especially if temperate or cold, and dry, will disperse or destroy them. Their action is manifestly the same by night and by day. When evaporation is most active during the heat of the day, they rise high in the atmosphere, and in proportion as the nights are cold and damp, so do they become condensed and lie closer to the ground. The fogs which prevail at night over marshes hold these malarious vapours in solution, and it is then all the more dangerous for men and animals to breathe them.

According to the researches of Moscati, Vauquelin, Thenard, and Boussingault, the dew which forms on the surface of plants contains a large proportion of organic matter.

* *Tennent*, Ceylon, vol. i. p. 43.

It is also a fact that animals left to graze in marshy regions night and day, are much more liable than man to the maladies which the malaria engenders. Even a few hours in a current of air carrying the mephitic vapours, have been known to occasion maladies of a peculiar type in man and animals.

The emanations are supposed to be all the more pernicious the greater the mid-day heat, as the mud impregnated with organic matter becomes more dried up and deeply fissured.

Anthracoid affections are particularly prevalent at this time, and especially during exceptionally dry summers. In Friesland, for instance, in 1872-3, more than 2000 cattle perished from these affections in August and September, and more than 800 in 1799. The diseases are unknown there when the summer is wet, and as soon as the autumnal rains set in they disappear. The same fact has been observed in other countries. The shepherds in the Italian Maremma ascend with their flocks to the mountains when the hot weather sets in, and animals would appear instinctively to know the danger they incur by dwelling in malarious districts at the most dangerous season.*

2. *Mode of Access of Effluvia.*

It has been much discussed as to the way by which the specific poison of malaria obtains admission to the animal body; for it may as well be confessed that we cannot attribute the production of malarious diseases to any known element in the mephitic air. It may be taken for granted that the functions of the skin are not sufficiently active in marshy districts to absorb much of the deleterious ingredient, so that its entrance in anything like a sufficient amount by this channel is a matter for doubt. Though the stomach offers a better mode of ingress, yet it is very unlikely that it is the most vulnerable point, notwithstanding that animals drink the water of marshes, and eat the plants when covered with dew. The secretions of the stomach may decompose or alter the active agent, or its potency may be diminished by being mixed with the large quantities of food generally present in the digestive organs of

* See Heber's "Journey through the Upper Provinces of India," vol. ii. pp. 143, 157, 158; also Hooker's "Himalayan Journals," vol. i. p. 101.

herbivorous animals. The pulmonary surface, however, is a far more likely channel for its entrance, as it is always open, and is endowed with great powers of absorption for either liquid or gaseous, or even very minute particles of organic matter; these can be carried directly to the blood, and by that fluid of course to all the organs.

A multitude of observations prove the extreme sensibility of the membrane lining the air-passages and pulmonary vesicles, and the rapidity with which it admits into the circulation any soluble or molecular matter that may come in contact with it.

3. *Incubation of Malarial Diseases.*

When the malarial poison has once become diffused in the blood, that fluid and the nervous centres soon become affected. The rapidity with which disease is developed depends, it would seem, upon the quantity introduced, its concentration, and the predisposition of the animal. Sometimes only a few hours is sufficient to bring about a fatal issue; and at other times it may require many days: depending, apparently, on the degree of alteration the blood has undergone before the various organs resent its effects. This state of latency is that in which the solids and fluids of the body are as yet unaffected to that degree as to show no changes, though the infecting material may nevertheless be developing alterations which will sooner or later produce marked symptoms.

4. *Effects of Malaria.*

Animals accustomed to malarious emanations will offer greater resistance to their pernicious influences than those for the first time subjected to them; the aptitude for their reception appearing to be lessened in those which have been affected, though complete immunity is never observed. It is not always the apparently feeble which are the first to suffer. On the contrary, it is far more frequently those in the best condition, whose blood is rich in nitrogenous matters, and whose tissues abound in albumen, which readily assumes a septic or putrid character.

The malarial poison, as already stated, is supposed to be organic matter, something akin to yeast, in its being capable of exciting a kind of fermentative process or decomposition in other organic substances, especially those of the living body.*

It may, then, be readily supposed that when it is mixed with the blood, this will sooner or later assume a septic condition, marked by more serious symptoms the larger the proportion of easily decomposable matters the vital fluid contains.

The enzoötic diseases usually observed in marshy or malarious regions, are chiefly those of an Anthracoid nature, in which a great change is noticeable in the composition of the blood, and in its circulation throughout the body. It coagulates feebly, and the extensive extravasations and engorgements, especially of the spleen, caused by this condition of the circulatory system, and the rapid decomposition of the blood, are very striking.

Davaine and others have found minute bodies—*Bacteridia*, a kind of Vibrio—in the blood, and it would appear that they are peculiar to this class of diseases; indeed, many observers have concluded that they occasion them. They exist not

* Fermentation and putrefaction are not nowadays regarded as purely chemical processes, but physiological ones; the chemical effects observed being merely the accompaniments or results of so-called vital acts. Minute organisms exist in the air—*Mucedines* and *Bacterium termo*—fungi and infusoria; in most, though not in all situations, the air is charged with living beings, which, by some high authorities, are looked upon as the true exciters of putrefaction and fermentation. They alight from the atmosphere, come in contact with dead animal and vegetable bodies, and by a vital process decompose them, abstracting from them, and assimilating, the elements they require for their nutrition and growth. At the same time they increase and multiply very rapidly, and in turn become wafted about from place to place, ready and capable of effecting the decomposition of other masses of dead organic matter. Under peculiar conditions of the system, certain maladies may be caused by the introduction into the body of these low forms of vitality. Thus it is, that in Anthracoid diseases bacteria are never absent from the blood, and we can easily comprehend how the micrococci of the atmosphere may become bacteridia when introduced into the animal fluids.

only in the blood of the affected ox and sheep—the animals most liable to this condition of the blood—but in that of all other creatures so affected. In man, for instance, when he has been inoculated from a diseased animal, these bacteridia are found in the malignant vesicle or pustule which has been developed as a result of this inoculation; and what is perhaps still more remarkable, the re-inoculation of animals with the dried scab of the pustule causes the development of the original disease in them, and the production in their blood of multitudes of bacteridia.

From this it will be observed that, though the disease is developed spontaneously in all animals belonging to the equine and ruminant species, including even the camel and deer, as well as the pig—its spontaneous development in the carnivora being doubtful—the fluids have acquired a new property; for a perfectly healthy animal inoculated with them, though it may not have been exposed to the original ferment, will be seized more or less promptly with the same disease, and its blood or exhalations will be capable of propagating the malady to an indefinite extent.*

This formation of a contagium in a general disease, and its propagation by inoculation, is a noteworthy feature, and one which will be referred to again.

ANIMAL MIASMATA.

An atmosphere vitiated by the prolonged agglomeration of a large number of animals in a small space, is sometimes the only apparent exciting cause of various specific diseases, generally of a serious character, and which may assume an epizoötic form. Overcrowding, faulty, or imperfect ventilation, and filth, render the air so impure, that specific contagious maladies, and oftentimes grave accidents, are the result. The

* In man, Intermittent fever is induced in malarious situations, but there are not many facts to prove that this disease is witnessed in the domestic animals. The spleen is certainly much involved in the Anthracoid maladies of the lower animals; but the disease which accompanies or causes its alteration, differs from that witnessed in man by its contagious character, particularly through inoculation.

pure air destined to complete the all-important function of blood-aëration, when altered in its chemical composition, and polluted by various gases and organic impurities derived from the pulmonary and cutaneous exhalations and the different excreta, occasions serious derangement of organs, consequent on blood alterations.

If we reflect for a moment on the paramount importance of the function of respiration, of the necessity there is for a pure atmosphere in order that this essentially chemico-vital process be carried on without restraint or limit, we can scarcely wonder that health suffers in proportion as it is interfered with.

1. *Nature of Animal Miasmata.*

Of the gaseous products of respiration, the most notable, perhaps, is carbonic acid gas, which is given off from the lungs in quantity varying according to the size of the animal, and other circumstances. When this gas exceeds a certain proportion in the air breathed by warm-blooded creatures, it is a positive poison. Its ordinary quantity in the air is 4 volumes per 1000; and when it rises to about 12 or 15 volumes per 1000, it materially interferes with respiration in horses, diminishes the oxygenation of the blood, causing mal-nutrition and, if in larger quantity, poisoning.

The carbonic acid gas is not the only dangerous compound in the atmosphere of confined dwellings. The animal heat which is given off warms the air surrounding them, expands it in volume, and therefore renders it less fitted for breathing; while the watery vapour given off by the skin and lungs still further diminishes its vivifying qualities. Other matters are also present from the decomposition of animal and vegetable matters, such as ammonia, known by its causing a smarting pain to the eyes, and lachrymation, as well as irritation to the air-passages; carbonic oxide, of which more than 1 per cent. is quickly fatal to animals; sulphuretted hydrogen, which, when present in the proportion of 1·25 or 4 volumes per 1000 of air, causes purging and rapid prostration in dogs and horses. Chaussier found that 1 part in 1500 of air killed a bird; 1 in 500 a dog; and 1 in 250 a horse.

But the most unhealthy ingredient is undoubtedly the effete organic matter given off from the bodies of living animals. It is believed to be partially suspended in the air, and to be present in the form of a molecular vapour, in combination with water, and is given off from the lungs, mouth, and skin, with a small admixture of epithelium scales and fatty substances. When drawn through sulphuric acid, this aërial organic matter darkens it; when mixed with pure water, it renders it offensive; and it decolorizes permanganate of potash. It is precipitated by nitrate of silver, shows its nitrogenous constitution by yielding ammonia, blackens on platinum, and is most readily absorbed by wool, feathers, damp walls, and wood-work. Horse-hair and straw absorb it feebly. Its existence is always betrayed by the peculiar repulsive and overpowering odour which assails one in entering an overcrowded, badly-ventilated stable or cowshed, or descending to the main deck of a faulty cattle or horse-transport ship. It is very difficult to get rid of, and does not diffuse itself equally through a limited space, but seems to hang in clouds, even when fresh air is admitted.

Animal miasmata do not always confine their action to the stable or locality where they are generated, but may be diffused beyond this radius, through the medium of winds, forage, the clothes of the attendants, &c.

2. *Effects of Animal Miasmata.*

The animal miasmata enter the body by the same channels as the malarious matters which cause disease, and produce their effects more or less promptly, according to their state of concentration, and the condition of the animals subjected to them. It is very probable that the organic constituent is the most pernicious, it having been proved experimentally to be highly poisonous.

Gavarret and Hammond, having removed the carbonic acid and watery vapour from expired air, found that the animal substance remaining suspended in it destroyed life rapidly. A mouse immersed in it expired in forty-five minutes.

Horses kept in such an atmosphere are feverish, nauseated, loathe their food, and drink large quantities of water.

All these products of organic change, consequent on functional activity, when they are not allowed to escape readily, prevent the transformation of the venous into arterial blood, and being again absorbed and carried to every part of the body, engender morbid conditions of a most disastrous kind. The specific contagious diseases (or rather forms of the same disease), known as "glanders" and "farcy" of the horse, have been, and with much reason, attributed to this cause. We have already given instances of the effects of this pollution. Personal experience in the conveyance of horses and other animals on shipboard, gained in three wars, has fully convinced me of the great mortality that will ensue when improper ventilation and crowding cause the creatures to breathe a strongly tainted atmosphere. Not only do Gangrenous maladies frequently appear, but also those of a highly contagious character; and the effects of this empoisonment sometimes do not pass off for a long period after disembarkation. Cases of Glanders among horses will appear for months afterwards, even in the most salubrious situations.

Animals which are debilitated in any way are most readily acted upon by these miasmata. Renault has shown that in the old crowded stables of the Alfort Veterinary School, cases of Pneumonia, as well as severe wounds, quickly assumed a putrid character, and nearly always terminated fatally; but when the buildings were enlarged, well ventilated, and fewer animals admitted, this mortality ceased.

And nothing is better ascertained than the fact that cows confined in low, badly-drained, filthy, and ill-ventilated cow-sheds, contract Tuberculosis; and pigs kept in small, dark, and hot piggeries, which are supposed to hasten the fattening process, are frequently the victims of disease. Bees which are overcrowded in closed hives before they are allowed to swarm, very often contract a putrid Dysentery, which is most destructive. Delafond gives an instance of a farmer in Beauce, who, in one night, lost sixty sheep out of two hundred which he had crammed into a confined space

provided with insufficient air. In 1792, during the siege of Mayence, Dysentery of a very aggravated character broke out among the horses and cattle closely confined in the casemates.

The pollution of the atmosphere by the decomposition of animals which have ceased to exist has, from the earliest times, been recorded as productive of wide-spread disease in man and beast;* and there can be no doubt whatever, that when animals are exposed to the influence of organic effluvia and noxious gases produced in this way, and to the exhalations of other living beings at the same time, we have a most potent cause in operation for the generation and spread of specific diseases of a putrid and pestilential character.

It is certain that putrefying animal matters, when inoculated accidentally or experimentally, or even when ingested, give rise to the gravest symptoms, and, in proportion to the amount, cause death more or less rapidly.

Of the infective power of this septic principle, we have numerous examples; but, perhaps, the most striking is that afforded when a cow aborts in a stable, and Septic inflammation of the uterus occurs. If other pregnant cows are introduced into this stable, they become infected, abort, and suffer from the same malady.

The general characters of the diseases due to malarial or miasmatic infection are, then, sufficiently marked; though even if we learn the source of the toxic agent which produces them, we are nearly always ignorant of its nature. The symptoms which characterize them are those attributable to a more or less serious alteration in the chemical composition and physical qualities of the blood, and particularly in the diminution in the proportion of its fibrine. Hence the tendency to malignity, putridity, the formation of abscesses and purulent deposits, &c., observed, especially in the horse. In the ox and sheep, we

* These occurrences are fully recorded in "Animal Plagues."

have the formation of tumours, gangrenous swellings, passive hæmorrhages, infiltrations of the connective tissue, and particular alterations in the lymphatic and glandular systems, &c.

CONTAGION.

THE diseases which owe their origin, maintenance, and extension to the presence of a virulent element or specific virus are designated "contagious," or "zymotic" (from *Ζύμη*, leaven), as they are occasioned by a poison which, entering the blood, is diffused throughout the body, and operates on it in the manner of a ferment. The term is a convenient one, as serving to bring together a number of maladies allied to each other by the similarity of their cause; but it is somewhat objectionable, inasmuch as it is based upon a mere hypothesis, for the correctness of which we have no trustworthy facts. Indeed, in some cases it is altogether inapplicable, as in those in which death suddenly follows the introduction of some atmospherical contamination or other cause of blood-poisoning, which gives not the least evidence of such a process as fermentation having had time to take place.

The class of diseases which are characterized as "contagious" being a most important one, and as many epizoöties appear and prevail through the operation of no other agency, apparently, than that of a contagium, it is very essential that this special agent be carefully studied.

We have seen that during the decomposition of animal and vegetable matters, and even during the life of animals, certain exhalations of an inorganic character, as well as organic effluvia and miasmata, are given off which produce serious effects on health. The gaseous substances—such as carbonic acid, sulphuretted, phosphuretted, and carburetted hydrogen, sulpho-cyanogen, ammonia, and other compounds—are especially indicated as sufficient to lower the vitality of the system

when evolved in sufficient quantity. Their mode of action has not been clearly defined, though it may be presumed that they chiefly act by preventing due oxidation of the tissues, and the elimination of effete matter from the circulation.

But these gases, though possessed of power to destroy life when in large amount, yet usually do no more than predispose the body for the reception or operation of a specific agent. There is no tangible proof that they alone are capable of generating any of those miasmatic diseases which present themselves enzoötically or epizoötically. With far more probability are we led to believe that the miasmata of particular maladies are organic in their nature, and derived from the decomposition, alteration, or transformation of organic matter, which, being received by the system ready for its reception, acquires the power of developing disease.

The extension of general diseases, as we have before noticed, may be due to the action of purely malarial or miasmatic agencies operating on many animals at the same time (the Catarrhal form of "influenza," for instance), or they may be spread far and wide by the sole means of this animal poison or contagium (when they are *purely contagious*—for example, the Cattle-plague, sheep Small-pox, &c.), or they may owe their extension to both causes (the *miasmatico-contagious* or *infecto-contagious maladies*, such as "foot-and-mouth disease," "anthrax," &c.).

INFECTION AND CONTAGION.

The terms *infectious* and *contagious* are usually employed to designate diseases which may be communicated from one animal to another—from a sick to a healthy animal; "infectious" (from *inficere*, to soil or corrupt), however, is used more particularly to distinguish those maladies which are transmissible through the medium of the air, or by substances of various kinds, which have been named *fomites*, without actual contact with the body of the diseased creature; while "contagion" (from *con*, with, and *tangere*, to touch) implies the more obvious conveyance of the specific virus by direct touch or contact, or by inoculation with the morbid material

from the diseased animal. Some authorites maintain that contagion is only one of the forms of infection, which, as we have before stated, is divided into four kinds—*virulent*, *miasmatic*, *septic*, and *parasitic infection*. But it is difficult to maintain the distinction between contagion and infection, as the contagium which is supposed to be carried by the atmosphere may be, in many cases, transmitted by actual contact. But though there is essentially and theoretically no difference between the terms, yet in practice it is frequently convenient to observe the distinction.

Diseases may be both infectious and contagious, or, though very rarely, they may be the latter only ; but they are never infectious without being contagious. They form a most important division of the zymotic class ; are nearly always acute in their progress ; prevail, by virtue of their mode of propagation, as enzoöties or epizoöties ; are most serious in their symptoms ; and are only too often, in the lower animals, most deadly in their character. At one time there were authorities who denied the existence of contagious maladies ; but they utterly ignored the facts derived from centuries of experience.

To control the spread of a malady which is generated from bad sanitary arrangements, or is due to atmospherical impurity of a kind that does not occasion communicable disease, will require very different management to that needed to extinguish one which depends solely on the existence of an animal virus.

To be able to determine whether a disease be contagious or not, is of the highest moment in veterinary medicine and sanitary science ; for when it can be positively shown that a certain malady is produced and spread by contagion only, the wisdom and energy of man can prevent its extension, and cause its extinction ; but a distempered atmosphere, due to occult conditions, cannot be corrected or controlled, and all that can be done is to fortify health by hygiènic measures.

1. *Nature of Contagia.*

The material contagious principle (speaking now only of that which is present in such diseases as Cattle-plague), which,

when transferred from the body of a diseased creature, in which it has been elaborated, to that of a healthy one, in which it occasions an analagous or identical affection, has been named a *virus* (from *vis*, violence), *morbigenous*, or *disease-producing element*, *viruliferous principle*, *contagium*, *biolytic* (or "*life-destroying*") *agent*, &c.

Of the manner in which it is elaborated, we know nothing for certain. What we do know is, that the virus of a particular disease preserves its identity; and that in each specific contagious malady there is a specific agent which has the power, under certain circumstances, of multiplying itself indefinitely, and always produces certain characteristic phenomena, no matter how frequently it may be transferred from one animal to another.

The specific action of these different factors is not modified by reason of the predisposition of animals, for they constantly produce the same series of morbid phenomena; if they fail in this, it is because the organism of the healthy animal is refractory to their reception.

This virus, or contagium, then, is a material animal poison, elaborated by a morbid process in the living body, and capable of inducing, under favourable conditions, a disease resembling, or identical with, that which has produced it, in the same or many different species of animals, and thus of regenerating itself to any extent. The most minute particle appears to possess a power of expansion and development which is truly astonishing. In this respect the virus of a contagious disease differs greatly from the animal poisons which are elaborated by a physiological process in certain creatures, such as snakes —their venom has not the power of regeneration when transferred from the organ which secreted it to the body of another animal, and can only operate by virtue of the quantity deposited in the living tissues. An infinitesimal portion—the most trifling particle—of an animal virus will give as certain results as a large quantity, and though this minute portion is rapidly increased in its new locality, yet it never loses its original properties. How it originates or originally sprung up, how it becomes increased, what it is, or how it comports

itself under varying circumstances, are questions which have not yet been elucidated to any satisfactory degree.

Contagion might, then, be defined as the transmission of a disease from a sick animal to one or more individuals, through the medium of a particular principle (or *virus*), the result of a specific and morbid elaboration; this principle being conveyed mediately or immediately, and producing in animals which are more or less predisposed, a similar disease to that which gave rise to it.

Contagious maladies, therefore, differ widely from those which are due to malarial or miasmatic infection, inasmuch as the first are due to diseased animals, and their spread depends upon these, the same typical phenomena being always reproduced. When these diseased animals are isolated, and the viruliferous principle cannot be disseminated, the maladies are extinguished. The others are dependent upon local causes, and disappear on the destruction of these; in addition to which, they do not present an invariable and special type.

2. *Characters Common to Contagious Diseases.*

Contagious maladies are propagated and maintained by a virus, have a period of incubation, and generally pass through a regular phase, their evolution being marked by more or less regular periods or stages, and nearly all are characterized by more or less general modifications of the organism. Otherwise, they differ greatly from each other in their symptoms, course, duration, pathological anatomy, and termination. Some are acute, others are chronic; some are manifested by general disturbance, without much, if any, local disorder, while others are the reverse. It is the same with the morbid alterations, though it may be observed that secondary lesions are generally rare in the contagious diseases of animals. Some appear suddenly, and terminate in death with terrible rapidity, as in Anthrax; while others are at times as slow in their progress, and may not terminate their course for months or years, as Glanders and the so-called "syphilis" of the horse.

3. *Origin of Contagious Diseases.*

With regard to the origin of contagious diseases, we might hazard the opinion, founded on what has been already said, that a combination of circumstances may, in the presence of certain conditions, concur in giving rise to special *materies morbi*, which will possess the power of being regenerated over and over again, and produce a specific or zymotic malady whenever introduced into the body of a healthy animal. All the ingredients necessary to its elaboration may be present, but one or more of the conditions being absent, this combination cannot take place. Like the several substances in a grain of gunpowder, they may be intimately mixed, but require the spark, the exalted temperature, in order to produce a new force, a new combination. We have every reason to believe in the spontaneous generation of some contagious diseases, such as Glanders, Anthrax, canine Distemper, Dysentery, Influenza, Strangles, &c., in our own and other countries; but there are morbid elements—special in their nature and in their effects—which, when they disappear, can only be again developed in situations and under circumstances peculiarly favourable for their production. Latitude and longitude have peculiar zymotic characteristics, which, in some instances at least, are not transferable; in others they are readily so; and such influences as are found at work in certain regions and in particular climates, may have power to generate a special disease which will thrive there, but will only be of an ephemeral character when carried elsewhere.

The so-called *spontaneous generation* of contagious diseases is a subject as fruitful in exciting discussion, apparently, as the spontaneous generation of the lower forms of animal or vegetable life. The doctrine that no contagious disease can be spontaneously developed may be satisfactory in theory, but in practice it will either be found altogether inadequate to account for many facts which come under daily observation; or if received as a law, at least as one which has important exceptions. The doctrine has been mainly based on the supposed identity between the phenomenon of the generation

of living beings and that of contagious maladies, but have we any proof that the two phenomena are identical? Nay, if we accept this doctrine without great reserves, are we not committing ourselves to a serious course, and one likely to cause us to neglect the great benefits which hygiènic measures confer in the prevention of such contagions as Glanders, &c.? There can be but little harm in considering some contagious maladies as capable of arising spontaneously, because it compels us to maintain animals in a proper state of health; while grave consequences might ensue did we deny the possibility of such development.

But it would be beyond the limits of this work to enter upon a review of the facts produced for and against the spontaneous origin of these maladies; suffice it to say, that though it may be admitted that contagion is in several diseases the sole cause of their maintenance and spread in our climate, yet it is scarcely possible to doubt that in some others which have been named, their virus may be generated *de novo.**

* With regard to the question as to whether the poisons of specific contagious diseases ever originate spontaneously, Dr. Budd, one of the principal opponents of the spontaneous theory, says: "I have myself come to the conclusion that there is no proof whatever that they ever do so. That the evidence, in fact, on which the contrary conclusion is founded is negative only; that evidence of precisely the same order—only to all appearance still more cogent—would prove animals and plants, even of large species, to originate spontaneously; that this evidence is, therefore, of no weight; and lastly, that, as in the case of plants and animals, all the really important facts point the other way, and tend to prove that these poisons, to use a word that is probably provisional only, like animals and plants, however they may have once originated, are only propagated now by the law of continuous succession. Opinions like these are no doubt at present those of a small minority. A very large, and by far the most influential, school in this country—a school which probably embraces the great majority of medical practitioners, and the whole of the 'sanitary' public—holds the exact contrary, and teaches that sundry of these poisons are constantly being generated *de novo* by the material conditions which surround us. In regard to the great work of prevention, it is obviously of the first importance to determine with which of these two parties the truth really lies; for so long as opinion remains divided as to this cardinal point, it is vain to hope for the general adoption of any definite scheme of preventive measures."—*The Medical Times and Gazette*, August, 1864.

We positively know that the air and other bodies may carry these peculiar miasmata from diseased animals, and that certain matters derived from these—such as the blood, mucus,

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With reference to the latter portion of this extract, there is no difficulty whatever in devising preventive measures, provided we know why and how certain contagious diseases are spontaneously produced. If they owe their origin to a violation of hygiènic laws—such a disease as Glanders or Anthrax, for instance—we have but to enforce the observance of these laws to prevent their recurrence ; and this is really successful.

Dr. Beale, who has given the subject of contagious and other diseases a large amount of attention, and from his independent and careful researches must be considered a high authority on these matters, attempts to account for the origin of contagious maladies. He says : "It is not improbable that in certain states of system the minute particles of bioplasm (living matter) in the blood may grow and multiply enormously, without ever being developed into white blood-corpuscles, just as many of the lower organisms multiply infinitely without one of the offspring necessarily attaining the highest state of perfection possible. The surrounding conditions may be adverse to the individual particles attaining their perfectly developed form, though favourable to their growth and multiplication in an immature state. The phenomena which occasion the formation of ordinary pus may, if they continue to occur for a long period of time, determine the development of a specific pus, which has still more marvellous powers of vitality. So it may, I think, be reasonably argued that if the ordinary feverish state be prolonged for a considerable time, and be severe in degree, it is likely that the bioplasm in the blood, collected in the capillaries, may give origin to bioplasm with marvellously increased powers of retaining its vitality, of growing and multiplying. The particles of this, making their way through the vessels, and escaping, may live for a considerable time, and having entered the blood of another person, may excite in it changes which accompanied their own development. Now, an organism which is about to be the subject of an ordinary feverish attack, would probably, if exposed to the influence of contagious disease germs, become the seat of development of a specific and perhaps fatal contagious fever. It is only reasonable to infer that a state of things favourable to the rapid growth and multiplication of disease germs, is not very different from the conditions favourable to their origin. . . . I think I am justified in advancing the doctrine that the germs originate in man's organism, and that they have descended from the normal bioplasm of his body. In ordinary febrile states, the bioplasm of the blood is increased, and it is not improbable that from the growth and multiplication of this bioplasm, under certain circumstances, contagious bioplasm of various kinds may result."—*Disease Germs; their Real Nature.* London, 1870; p. 169.

pus, serum, saliva, and other products of secretion, various exudations, flesh, expired air, excrements, cutaneous emanations, &c., which are usually designated the *vehicles of the contagion*, are tainted with them and transmit them readily to other creatures. Or they may be transferred and attached to animate or inanimate bodies, which are then named the *bearers of the contagious principle*, and it is frequently through the intervention of these that contagion takes place.

4. *Volatile and Fixed Contagia.*

A consideration of the facts which comparative pathology has furnished lead us to the conclusion that there are "permanent," "necessary," or "original contagia" (*contagia permanentia, necessaria*), as well as those which are "temporary," "accidental," or "secondary." The first are absolutely essential to the existence of certain maladies in the lower animals and in man; such as, for the latter, Small-pox, Scarlatina, Measles, &c., and for the former, Cattle-plague (in Western regions at any rate), contagious Pleuro-pneumonia, the Variolous disorders of animals, &c. If the virus of these maladies could be destroyed, they would no longer exist. The second class of contagia, on the contrary, is only developed during the course of diseases which have been produced without the agency of a virus, and by different influences. There are maladies which readily become contagious, and others in which the development of a contagium is rare. Heusinger maintains that there is no disease which it would be safe to assert could never become contagious under favourable circumstances. We might adduce certain Catarrhs, and "strangles" and "influenza" in the horse, "distemper" in the dog, and some purulent inflammations of the generative organs, as examples of diseases which, occurring without the presence of a virus, may nevertheless become contagious.

The contagious principle is generally supposed to, and indeed practically does, exist in two conditions with regard to the atmosphere. These have been named the *volatile* and *fixed* states.* In the "volatile" form, the contagia have the air for

* The distinction is convenient, but incorrect, so far as *volatility* is con-

their medium or "vehicle;" and in the "fixed" state they attach themselves to liquid or solid matters, and can only be conveyed by mediate or direct contact of sick with healthy animals. There is but little, if any, difference between these two conditions, however, so far as their effects are concerned, as they are equally efficient in bringing about their specific phenomena, and the contagium must be brought into contact with certain parts of the body before these phenomena are manifested.

There is a difference between them, however, with regard to their mode of transmission—a difference which has most important bearings, so far as sanitary measures are concerned. The *fixed virus* contained in the animal matter which is appreciable to our senses, requires what we may call "direct contact" of the diseased with the healthy animal, or with the bearer of the contagion, so that the virus may be deposited on a living and absorbent surface; whereas, when it is in the so-called "volatile form," it is sufficient for it to be given off with the vapours from the infected, and mixed with the air which healthy animals breathe, in order to be engrafted in them and develop its special action.

5. *Vehicles, Media, Conductors, or Bearers of Contagia.*

The volatile and fixed forms of a contagium may adhere to various bodies or substances which will preserve their properties for a greater or less time. Porous matters of animal or

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cerned, if we are to regard the contagious elements as consisting of solid corpuscles, incapable of becoming converted into a vapour or gas. We have no evidence whatever that they possess this capability, nor is it necessary that they should; for much larger particles can be carried into the air and wafted to considerable distances; indeed, the atmosphere is constantly loaded with all kinds and sizes of atoms. Volatility, however, does not imply a capability of becoming gaseous or vaporous. Perhaps, nevertheless, the term "diffusibility," when employed to indicate the transmission of a contagium by the atmosphere, would be more correct, as expressing the property of bodies to become diffused in a state of extreme division in a liquid or gaseous medium, at any temperature. Mercury is diffused in the atmosphere in this form, even when the temperature is at freezing point. There is no fluid which can be considered fixed or non-diffusible in the calmest atmosphere.

vegetable origin—as straw, hay, wool, the skin, hair, horns, and feathers of living or dead animals, and various other media—are capable of serving as depots, and the period during which their activity may be preserved in these substances is variable, depending, as it does, on their inheritant vitality and many external circumstances. Living animals are the best carriers.

All substances are not equally capable of becoming bearers of contagion ; their are *good bearers* or *carriers*, among which Röll mentions bodies with a rough or velvety surface—such as wool, cotton, hair, feathers, linen and woollen stuffs, skins, &c., and *bad carriers*, or *isolating bodies*, to which the contagious principle attaches itself with difficulty or not at all. Smooth, dense bodies, such as metals, glass, resins, varnished surfaces, greasy matters, &c., belong to this category.

6. *Parts of the Body which secrete or contain the Virus.*

The parts of the body which secrete or contain the virus of the various contagious maladies are very different. Some contagia are extremely localized, as that of a primary Chancre, or the purulent Ophthalmia of man, or in the malignant Pustule in its early stage, or in the Foot-rot of sheep ; while others are found in many secretions, fluids, and tissues of the body, as in Glanders, Anthrax, Cattle-plague, &c. Some, even when so diffused in the organism, are more concentrated in certain fluids than others. The virus of Rabies exists in its most potent form in the saliva, that of Glanders in the nasal discharge, that of Pleuro-pneumonia in the diseased lungs, of Foot-and-mouth disease in the saliva and vesicles, and in the Variolous maladies in the pustules.

7. *Diffusion of Contagia.*

The diseased animal in which the process of elaborating a specific virus is going on, is a centre or focus whence may be diffused the virulent element in every direction, be it in a fixed or a volatile state. In the latter, or what we may term the "invisible condition," it may escape in the exhalations from the lungs, skin, or excretions and secretions, become mingled

with the atmosphere, impregnate everything that surrounds it, be carried to distances more or less great, and infect animals which may be in what is termed good health. This is the most dangerous form a virus can assume, inasmuch as it is one which severely tests the best devised sanitary measures; one which is most likely to mislead the ignorant; and also one which the unbelievers in contagion found their chief arguments upon.

The precautions to be taken to avert the extension of a disease which depends upon a fixed virus, are generally of a simple and easily enforced character. We have only to isolate the diseased from the healthy in a thorough manner, and to disinfect the various articles which may have become impregnated with the virulent element, in order to cut off the resources upon which the malady depends for its maintenance.

But when the poison is in what we will suppose to be the aërial form, not only must these measures be rigidly carried out, but the atmosphere surrounding the diseased animal must likewise be disinfected, and every creature or substance in its vicinity, or where it has been while diseased, must be purified.

It is a matter of observation that the body of an animal of the same species as that which is affected, may even become a medium for transmitting the contagium without itself being involved. Droves and flocks leaving a country where a contagious malady is raging, have been known to communicate the disease to the animals in the new region to which they have been carried, without being attacked themselves. This accident, however, depends on certain conditions, such as the vitality of the virus, its potency, &c.

8. *Infection Radius.*

The distance to which the virulent exhalations can be carried is undoubtedly dependent, not only on varying conditions, but is also intimately connected with the nature of the virus of particular diseases. The investigation of this subject, however, has not been very closely pursued, and much has yet to be learned with regard to it. It may be accepted as a fact,

nevertheless, that certain contagia—those which are fixed to a material vehicle—can only act within a very limited distance from the diseased creature, and by *immediate transmission ;* or be carried by substances or other animals, when we have *mediate transmission*—these are the fixed contagia. Others may, as already mentioned, have the atmosphere for their vehicle, being thrown off into it by the lungs, skin, &c., and may consequently travel a certain distance—such are the volatile contagia. The latter are generally most subtle and potent—infinitely more so than the others ; and it has been demonstrated that in this respect they differ in different animals and different diseases. For example, the viruliferous principle of Cattle-plague is perhaps unequalled among the whole of these poisons for its extreme subtlety and power ; that of the Sheep-pox is not much less so, while that of Aphthous fever is not so insidious or potent ; the virus of contagious Pleuro-pneumonia is still feebler, and that of Glanders of the horse even less than it.

The capability of some of these agents to reproduce themselves in the living organism is very great, even when they have been disseminated widely and for a long period in the air, or lodged in substances of a very dissimilar nature.

Abilgaard, a distinguished Danish veterinarian, thought he had established the infecting power of the Cattle-plague to be limited to a distance of not more than twelve or eighteen feet; and Jessen, another careful veterinary observer, has remarked that a healthy herd separated from a diseased one by a stream only twenty-five feet wide, was not infected. Sick thought a dozen feet was the limit ; Hayne gives it as from thirty to five hundred, and even a thousand feet ; while Wehenkel puts it down as from sixty to a hundred feet ; Kausch at two hundred, and by winds to four hundred feet.

Veith thought he had evidence to prove that the infecting principle of Sheep-pox could be carried a thousand feet by a strong current of air. Haubner gives an instance in which the contagium of bovine Pleuro-pneumonia was carried in this way from a diseased herd at pasture, to a healthy herd eighty to a hundred paces distant ; and from the manure of diseased

cattle to a distance of three hundred paces. Korber asserts that Influenza of the horse is infectious at a foot from the sick animal.

Locality, predisposition, and the intensity of the epizoöty may, however, considerably augment or diminish the radius within which the emanations from a diseased animal will be effective in transmitting the malady. In confined spaces, unnaturally heated by overcrowding, where the air is stagnant and filth abounds, the conditions favourable to the extension and intensification of the infecting element are multiplied. On the contrary, free ventilation, pure air, sunlight, and cleanliness will, in most cases, materially aid in destroying or attenuating the zymotic or pestiferous agent.

But here again the limit is wide. The intensely virulent element on which the diffusion of Cattle-plague depends, would often appear to be capable of withstanding salubrity of situation, and to defy the most careful sanitary arrangements.

There can be no doubt that this disease at times (as in England in 1865), has been spread far and wide in some districts, and without the intervention of any living creature; but merely from the fact that the contagious element became so abundant and intense, through keeping hundreds of sick animals alive to try the effects of medical treatment, that the atmosphere became saturated, so to speak, for miles around, with the pestiferous molecules.

It cannot be disputed that the winds have some influence in extending the sphere of action of the contagious particles,—currents of air being capable of transporting them for some distance.* The observations of Jessen, in Russia, with regard

* "The nation of the Tongusy," says delightful old John Bell, of Antermony, when speaking of the half-savage tribes he met in Siberia, "was very numerous; but it is of late much diminished by the Small-pox. It is remarkable that they knew nothing of this distemper till the Russians arrived among them. They are so much afraid of this disease, that if any one of a family is seized with it, the rest immediately make the patient a little hut, and set by him some water and victuals; then packing up everything, *they march off to windward*, each carrying an earthen pot with burning coals in it, and making a dreadful lamentation as they go along. They never revisit the sick till they think the danger is past. If

to Cattle-plague, as well as facts gathered during the prevalence of the same disease in this country and elsewhere, corroborate this statement. Indeed, the extreme volatility of the virus of this malady, and the distance to which it may be transported by the atmosphere, has caused the disease to be compared to the human plague.

All the materials which serve as depots for a contagium may also be the means of conveying it to great distances, when they are carried from the place where they became depositories.

Living creatures, for the same reason, will become ready vehicles for the transport of infectious germs, and even insects may at times prove efficient accessories in the diffusion of virulent matter.

The diffusion of the germs of contagious diseases may thus be dependent on a variety or combination of circumstances, all more or less apparent and possible.

9. *Physical Characteristics of the Disease Germs.*

The intimate nature of the contagious element has not yet been ascertained in any medium, except by the specific pathological reaction it induces when received into a living body previously healthy; in this way only can it be best studied. Physical and chemical investigations have been numerous, and still we are far from having arrived at any definite knowledge as to what is really the character of a virus when isolated from its media. Ingenuity has, therefore, been busy in devising theories to satisfy certain views entertained by different authorities. Henle proposed the theory of "organic parasitism" (to be alluded to hereafter), which considers contagia as organic particles, which, being generated in a diseased body, and while preserving their pathological vitality, may, when transferred to another organism, produce a diseased condition similar to that which produced them.

Another is the theory of animal or vegetable parasitism; a

the person dies, they place him on a branch of a tree, to which he is tied with strong wythes to prevent his falling."—"A Journey to Peking in 1719." London, 1764.

third that of fermentation, which differs but little from the latter in several particulars, and the fourth suggests the possibility of the organic compounds of the body submitting to certain alterations by which they have acquired the property of transmitting to all other organized matters a similar condition.

Recent investigations give us good reason to hope that, with at least some of the contagia, we shall be able to ascribe their potency to the presence of tangible particles rendered visible by the microscope, notwithstanding the great difficulties to be overcome in isolating and examining these. We know that they are ponderable matters, for they are diffused as such, and comport themselves with chemical re-agents as these do.

Dr. Beale remarks : "The *materies morbi* of contagious diseases does not consist of lifeless organic matter or inorganic matter, nor of any form of gas or vapour generated in the decomposition of animal or vegetable substances, nor by any matter set free during the decomposition of fæcal or other excrementitious matter of animal origin ; nor is it any species of animal or vegetable organism or parasite ; but the active contagious material consists of exceedingly minute particles of living germinal matter, which may be regarded as the direct descendants of the germinal or living matter of an organism which has been for some time living under unusual conditions. Contagious poisons affecting man and animals originated in their organisms. The living or germinal matter of some contagious diseases originating in the bodies of animals, may grow and multiply in man, and *vice versâ*. These particles of living germinal matter may retain their vitality for some time after they have escaped from the seat of their formation. . . . The smallest particle (less than the hundred-thousandth of an inch in diameter) being introduced into the body already in a fit state for its nutrition, may grow and multiply, giving rise, in due time, to the symptoms characteristic of the particular disease, and producing millions of particles like itself."*

* In 1863, Beale made a drawing of the appearances he observed in these particles from a drop of perfectly fresh vaccine lymph, and published it, with his remarks, in the Quarterly Journal of Microscopical Science, for April, 1864. Chauveau described them in 1868.

The fluids possessing the virulent property may be as clear and transparent as water when examined by the naked eye; and when scrutinized by the aid of even the highest powers, although solid particles are detected, sometimes in great number, there is nothing at all peculiar to be observed which would enable us to form any conception of the wonderful properties they possess, and the marvellous and oftentimes disastrous effects they produce.

The active particles of living matter, or *bioplasm*, found in the body, have been named *biads* (βια force, βιος life); they are extremely minute, for Beale has found some less than the fifty-thousandth of an inch in diameter, and he had no reason for believing that they were the smallest. They are diffused through the fluid, and to them is probably due, as Beale suggests, the movement in the finer vessels and spaces; and this constituent of the blood is in all likelihood the most important, for its increase or diminution may occasion serious disease or death. "This almost impalpable living, moving matter is the seat of many very important changes, and is perhaps influenced before any other constituents of the body when certain poisons and disease germs find their way into the blood." Protection after vaccination, or after an attack of some contagious diseases, is most likely brought about by changes induced in this living matter.

The same authority is of opinion that the infecting particles are merely altered or degraded bioplasm, endowed with new and specific properties.* "I consider it almost certain that

* "Disease Germs: their Real Nature." Various other investigators have enunciated a similar opinion. Dr. Richardson thinks that all poisons capable of producing epidemic disease are the natural secretions of the body undergoing a modified condition, by which they are rendered poisonous, and which occurs either by contact with a pre-existing poison, or by direct decomposition under the influence of atmospheric air; that animal poisons so generated are alkaloidal in character *(animal alkaloids)*, holding the same position in the animal economy that alkaloids do in vegetables; that when once a point of poison is deposited on a secreting surface, as upon a mucous membrane, its further increase does not depend upon propagation from cell to cell, but from the continuance of the natural secretion, and from the metamorphosis of such secretion into poisonous

the material of which these particles are composed have the power of forming matter like itself from pabulum around it, which differs from it in properties and composition. . . . The material grows and multiplies, and produces its kind as all living things do, and as nothing that does not live has been proved to be capable of doing. . . . The most tiny morsel of this virulent, rapidly-multiplying morbid bioplasm, may give rise to a contagious and fatal fever." In the blood removed from the smaller vessels, in the mucus secretions of the mouth and intestinal canal, and in the milk of animals suffering from Cattle-plague, Beale found multitudes of these minute particles of bioplasm, "which," he remarks, "as long as they remain alive, are, without doubt, disease-carrying particles." He also thinks it not improbable that a few of the contagious disease germs actually acquire their virulent properties after they have left the organism in which they have been developed, and while they remain immersed in extraneous media containing the proper elements for their nutrition and further development. Should this surmise prove correct, it will explain much that is now mysterious with regard to the origin of contagious diseases.

The eminent physiologist and veterinarian, M. Chauveau,

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matter after it is thrown out." M. Robin, another distinguished authority, is of opinion that the virus of a contagious disease operates in the blood as a kind of catalytic agent, by an "action of presence," or organic, isomeric, or animal catalysis; its inherent catalytic force resolving the fluids and solids it encounters into its own likeness or nature, without being changed itself.

The chemical view is generally that promulgated by Liebig as follows: "A substance in the act of decomposition, added to a mixed fluid in which its constituents are contained, can reproduce itself in that fluid exactly in the same manner as new yeast is produced when yeast is added to liquids containing gluten."

But the fermentation theory is scarcely applicable in contagious maladies, inasmuch as the product of fermentation is subordinate to the kind of fermentiscible fluid, and not to that of the ferment itself. The action, therefore, of different ferments on one fluid alone, the blood, should be always the same; but pathology demonstrates that this is not so, each virulent disease having a different class of symptoms and distinctive pathological alterations.

of the Lyons Veterinary School, has not only verified the presence of these contagiferous atoms, but he has experimentally put their properties to the test of experiment, by isolating them from the media in which they are carried.

In the virus of Vaccinia, Variola, Glanders, and Cattle-plague, he has established the fact that there is a liquid and a solid portion, the first being merely the medium, the second the active principle. The latter consists of extremely fine, solid, or granuliform particles suspended in the first, and are alone endowed with virulent properties. Repeatedly washed, to cleanse them from the liquid portion and all soluble matter, and then suspended in a certain amount of distilled water, when inoculated they occasioned the same disease as that which had produced them. Experiments with the virus of human Small-pox, ovine Small-pox, Glanders, and Cattle-plague, yielded most interesting results. The character of the virulent matter was in appearance the same in all these diseases, though the difference in the degree of virulence was most marked. This difference, it would appear, is due to the number of virulent granules in a given quantity of matter. The expired air contains comparatively few germs in such a malady as Cattle-plague; while the tears, nasal discharge, saliva, milk, urine, and excrement contained a prodigious quantity.* The virulence of Glanders was found to be remarkably developed. In this disease, as is well known, tubercle and abscess in the lungs is a common pathological feature. The pulmonary abscess is filled with a white, muco-purulent fluid, which more particularly contains the virus of the disease: a virus so intense, says M. Chauveau, and endowed with such a

* Even before Chauveau, Sanderson was led to conclude, in 1866, that the virus of Cattle-plague contained these viruliferous particles. The discharge from the nostrils was subjected to diffusion in an ordinary diffusion-cell, furnished with a diaphragm of parchment paper, for twelve hours. Animals were inoculated with the diffusate without effect. The extreme activity of the Cattle-plague virus gave great value to the result; for, even if a very small quantity of it has passed through the septum, it would have rendered the liquid active. Onimus has obtained the same results with septic blood. The non-diffusibility of the contagium of the specific diseases appears to be now accepted by all pathologists.

prodigious activity, that it is one of the most virulent humours known to exist. Dilution affected it but little; in five hundred times its weight of water, when inoculated by puncture into the skin of a horse or ass, it was as potent as when undiluted: a proof that the fine molecular granules are very numerous.

On the other hand, with vaccine virus diluted in from twice to fifteen times its weight of water, inoculations were nearly as successful as with pure vaccine; but between fifteen and fifty times there was much uncertainty, especially with the higher dilutions. In all the cases in which inoculation succeeded, however, the eruption comported itself exactly in the same manner as if the virus had been undiluted.

10. *Elaboration of Disease-Germs.*

The manner in which these particles are developed has also been made the subject of careful observation by Chauveau. After inoculating a sheep with the virus of ovine Small-pox, he found that, in making a vertical section of the pustule which was subsequently produced, the subcutaneous connective tissue participated largely in its formation, having become transformed into a thick gelatinous layer, from which it was possible to extract a great quantity of extremely virulent liquid: proving that the pustules are the most active centres in the elaboration of the specific agents of the malady, and indicating that it is in them that the study of the genesis and multiplication of these germs is most likely to be successfully carried out. He also remarked that, at the commencement, the irritation is distinctly limited to the skin itself, and more particularly to the surface of the derma and rete mucosum, as well in the spontaneous as in the inoculated pustule; extension of the morbid process ultimately involving the connective tissue. It is easy to discover when this extension occurs, and when the first modifications caused by the propagation of the specific irritant begin; this is the moment to choose for the study of the viruliferous elements. If one of the variolous vesicles is excised at this initial period, when the skin is only red and scarcely swollen, and the traces of the gelatinous substance

which is beginning to appear on its under-surface be removed by a pair of scissors, then squeezed into a little water on a glass, and a healthy sheep is inoculated, the animal will become affected as readily and effectively as if the matter had been extracted from a perfectly developed pustule. This shows that the virulent element is present when the very earliest local symptoms of irritation offer themselves.

The skin so removed, when carefully and properly prepared for microscopical examination, exhibits :—1. Fasciculi of conjunctival tissue ; 2. Interfascicular cells in process of proliferation ; 3. Around the vessels, elongated, and more or less considerable, masses of white globules. The fasciculi of conjunctival tissue do not yet appear to be altered ; but all the interfascicular cellular elements are considerably multiplied and developed. There are very large oval or spherical parent-cells, each containing from twelve to fifteen small cells. There are also ramifying, and even anastomosing cells, which only differ from the normal cells of the conjunctival tissue by their distention. The most numerous elements are the simple cells without prolongations. There are also masses of Leucocytes, or white globules, accumulated along the sides of the vessels.

A character common to all the cellular elements consists in the mass of protoplasm or bioplasm of which they are composed, being always granular ; though at this early period few, if any, granules exist in a free condition outside these cells. This would tend to demonstrate that the virulent granules are not independent elements, multiplying of themselves, but form part of the cellular protoplasm in which they arise and are developed ; though they possess the same activity when free as when contained in this protoplasm.

It must be observed, however, that the same anatomical characters are observed in the products of non-specific inflammation ; so that, in reality, there is no difference in this respect between the most virulent germs and the least hurtful.

The disease germs are far from always having the same volume, aspect, optical properties, or chemical characters ; and they differ considerably in the various contagious diseases, with

regard not only to the regions in which they are to be found, but even in the different parts in which they are located.*

* Cohn has confirmed the presence of the Bioplasts described by Beale and Chauveau, in an examination of perfectly fresh Small-pox and vaccine lymph, most carefully preserved. Among other constituents, he observed very minute granules or globules, whose refrangent power so closely resembled that of serum that they were difficult to discover. At first these elements were generally isolated, very rarely were they joined to form the figure 8 ; but if kept at a temperature of 35 degrees Cent. for a few hours, they had not only considerably increased in number, but elongated groups appeared, formed of six, eight, or more globules. These particles are very movable on each other, and in time from chaplets give rise to cells of variable volume. The latter evidently multiply in a very active manner by division or gemmation, but their minuteness is an obstacle to the direct verification of this phenomenon. Proliferation continues for several days. In old lymph the corpuscles have increased in volume, their contents are more refrangent, and they adhere closely to each other through the medium of mucus substance (a mass of *Zooglœa*). These elements have only a molecular movement. Cohn characterizes them as *Microsphœra* (globular Bacteria), belonging to the family of Schizomycetes (particles which form the lowest degree in the scale of animate life, and which Nagèli has distinguished from the fungi), group of Bacteridæ : "colourless cells, very minute, globular or spherical, generally immovable, multiplying by division or gemmation in the shape of moniliform chains of two, four, eight, or more particles, becoming by their displacement irregular groups, developing through multiplication into cellular masses or colonies, or finally becoming agglutinated, through the medium of an intercellular mucus substance, into parcels of zooglœa, with probably stable cells." With Keber and Chauveau, Cohn believes these corpuscles to be the essential agents in contagion, because they are identical with those found by Weigert in the skin of several people who had died from Small-pox. According to Cohn's experiments, the globular Bacteria always act as ferments, and develop in urine, the spleen, albumen, &c., the products of decomposition. He admits, by analogy, that the microspheres of variolic lymph also act as a ferment, and give rise, in that lymph, to a product of decomposition capable of giving rise to a specific morbid process.—*Virchow's Archives*, p. 229, 1872.

The results of Cohn's experiments are largely corroborated by the more recent researches of Karsten, who is of opinion that the Bacteria are developed from altered cells, and that the supposed organisms associated with most forms of decomposition originate in a similar fashion ; the mode of development of the cells being dependent upon the chemical nature of the cell fluid and the matter and force acting from without. Thus, in albuminous fluids putrefaction concurs with the production of *Bacteria*

11. *Odour of Contagious Diseases.*

Whatever may be the exact nature of the virulent germs, and the cause for their acting differently in different diseases, the sense of smell not unfrequently comes to the aid of that of vision in distinguishing between certain specific maladies. For there can be no doubt whatever as to the fact, that particular affections of this kind have peculiar, and sometimes most persistent odours, which are in all probability due to the contagia of these diseases—to the virulent particles themseves. For example, the disgusting character of the effluvia from a person suffering from confluent Small-pox is notorious;* the indescribably mawkish, insipid, honey-like smell of sheep Small-pox can scarcely ever be mistaken, neither can that of

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and *Vibrios:* the very forms whose production in such fluids has been of late years so frequently appealed to in support of the theory of spontaneous generation of living organisms. According to Karsten, then, these *Bacteria* and *Vibrios* are merely pathological forms of cells. But it would appear that even these are not formed unless the air, with its contained germs, has free access to the fluids experimented upon.

* A remarkable proof of the subtlety and power of the odour of the contagia of some zymotic diseases, is afforded in the description given by Sir J. Emerson Tennent, of Small-pox in Ceylon. The cheetahs, or leopards, it appears, are strongly attracted by the peculiar odour which accompanies it. The reluctance of the natives to submit themselves or their children to vaccination, exposes the island to frightful visitation of this disease; and in the villages in the interior it is usual on such occasions to erect huts in the jungle to serve as temporary hospitals. Towards these the leopards are certain to be allured; and the medical officers are obliged to resort to increased precautions in consequence.—*Ceylon*, vol. i. p. 141.

This fact is connected with a curious native superstition. Amongst the avenging scourges sent direct from the gods, the Singhalese regard both the ravages of the leopard and the visitation of the Small-pox. The latter they call, *par excellence*, "maha ledda"—the great sickness; they look upon it as a special manifestation of deoidosay—"the displeasure of the gods;" and the attraction of the cheetahs to the bed of the sufferer they attribute to the same indignant agency. A few years ago, the Capua, or demon priest of a "dewale" at Oggalbodda, a village near Cattura, when suffering from Small-pox, was devoured by a cheetah, and his fate was regarded by those of an opposite faith as a special judgment from heaven.—*Half-yearly Abst. of the Med. Sciences*, vol. xxvii.

Distemper in the dog; and what is more striking in Cattle-plague, than the odour of the emanations proceeding from the body of a diseased animal while alive, or even portions of it after death? The extremely subtle nature of these particles may be divined from the fact, that they can be perceived in the perspiration, clothes, urine, &c., of the persons who have been much in contact with the affected animals, for many hours afterwards.

A somewhat notable circumstance connected with the odour of some of these contagious diseases, is observed in the decrease in the intensity of this peculiarity as they diminish in malignity; the milder the attacks become, so to a corresponding degree does the characteristic smell grow fainter, and the more hope there is of a favourable termination.*

We will hereafter allude to the contagious maladies which owe their diffusion to the presence of animal or vegetable parasites, or minute organisms supposed to belong to either of these. In the meantime, we have only to deal with those

* The peculiar odour of different animals is doubtless due to particles given off from their bodies, and particularly their skin; and the subtlety and tenacity of these is in some instances quite extraordinary. We are all more or less familiar with this fact, but perhaps the most striking example noted by any observer is that given by Darwin. At Maldonado he found the native deer (*Cervus campestris*). "The most curious fact with respect to this animal, is the overpoweringly strong and offensive odour which proceeds from the buck. It is quite indescribable; several times, whilst skinning the specimen which is now mounted at the Zoological Museum, I was almost overcome by nausea. I tied up the skin in a silk pocket-handkerchief, and so carried it home; this handkerchief, after being well washed, I continually used, and it was, of course, as repeatedly washed; yet every time, for a space of one year and seven months, when first unfolded, I distinctly perceived the odour. This appears an astonishing instance of the permanence of some matter, which in its nature, nevertheless, must be most subtle and volatile. Frequently, when passing at the distance of half-a-mile to leeward of a herd, I have perceived the whole air tainted with the effluvium. I believe the smell from the buck is most powerful at the period when its horns are perfect, or free from the hairy skin. When in this state the meat is, of course, quite uneatable; but the Guachos assert that if buried for some time in fresh earth the taint is removed."—*Voyages of the Adventure and Beagle*, vol. iii. p. 56.

diseases which at present there is reason to believe belong to neither of these categories, but each of which have a special germ of its own, endowed with exclusive and specific properties that confer upon it the power of indefinite development and transmissibility, and which remove it altogether from the catalogue of ordinary agents. Beyond what has been already mentioned, we can say nothing as to the nature or character of these germs, and can only judge of them by the more or less extensive organic perturbations to which they give rise. They are the product of vital changes, mysterious in themselves; and their isolation and examination is only an achievement of modern science, the results of which have not yet been adequately realized. In what their power consists we are in absolute ignorance.

The moistened fang of a rabid dog will carry death to many creatures of very different species, and yet we can perceive no sensible alteration in the saliva to account for its newly acquired and deadly properties. The apparently limpid tear that courses down the cheek of the plague-stricken ox, may yet contain within itself an invincible energy, capable of destroying the flocks and herds of a whole country; while a single inoculation with an infinitesimal quantity of matter from the nostril or lung of a glandered horse may soon become so increased and potent, as to unhorse a division of cavalry.*

12. *Reception of the Contagium.*

As has been stated, when speaking of a particular aptitude in order that a contagium may prove effective, it must be introduced into the body of a susceptible animal whose system is predisposed to receive it. With regard to this "receptivity" or "predisposition," as we have named it, there are contagia which exert their influence on only one species of animal, or on closely allied species; for instance, contagious Pleuro-pneu-

* It is computed that in Mexico, from the contagion received from the negro who was landed on that coast in 1520, affected with Small-pox, three and a half millions of Indians perished—such desolating power had the virus elaborated in that individual.

monia only attacks cattle, as a rule ; Cattle-plague is generally regarded as a bovine malady, but it may affect all ruminants ; sheep Small-pox only affects sheep ; Glanders and Farcy are equine diseases ; Aphthous fever attacks pigs as well as ruminants ; and other diseases are capable of being transmitted to different species than that in which they primarily appeared, inducing in them an identical or very slightly modified disease, in which the virus may or may not be reproduced ; as examples, we may give Aphthous fever, Rabies, Horse-pox, Anthrax, &c. As was also mentioned, certain animals may resist the action of the contagion for a long time, but will ultimately yield to its influence ; while a few may altogether prove refractory. Cattle-plague, and Foot-and-mouth-disease, for example, affect the majority, or nearly all, of the animals liable to these diseases when they first appear ; contagious Pleuro-pneumonia attacks about twenty, and Rabies somewhat more or less than fifty, per cent. Temperature and other influences may vary this susceptibility, however, and especially in those cases in which the contagium obtains an entrance by inoculation on the surface of the body. In winter, for instance, when the ears of the sheep are cold, inoculation with variolous matter is not nearly so successful as in summer, when they are warm.

For some contagia there exists a more general and widespread receptivity than for others ; some appear to have a preference for animals in good condition and vigorous ; others prefer the weak and sickly ; and others, again, attack indiscriminately the strong and the weak.

Infection also depends on the energy of the virus, which is influenced in some cases according to the form of the disease producing it, as well as the stage of the disease, external comcomitant influences, the condition of the organism, &c. Towards the decline of an epizoöty, for instance, certain animals only offer mild and incomplete symptoms of the disease, and the virus has lost its potency to a great extent.

Some contagia preserve their primitive virulency, and even acquire a greater potency, by transmission ; those of Glanders and Anthrax, for example. Others become weakened by

transmission : as the virus of Sheep-pox and Cow-pox does by successive inoculations.

It may be observed, that the contagia peculiar to man have, as a rule, no action on the lower animals ; while nearly all the contagious maladies occurring in them,—and they are much more numerous—are transmissible to the human species ; and some of the contagia—that of Glanders in particular—even acquire a terrible potency when re-transmitted.

13. *Mode of Access.*

The various channels by which the disease germs may enter the body, is a subject not without interest to the pathologist. We have seen that the particles which have been proved to be the infecting agents are extremely minute, and that they may be carried by air-currents to considerable distances, and be deposited on animals or other objects ; and we have also mentioned that they are contained in certain fluids and solids of the body, or are attached to foreign substances, which become the bearers of these germs. Not only do these particles fail to produce their effect in a healthy body, unless they find themselves in the presence of conditions which favour their development and multiplication, but the parts (or *atria*) which are disposed to submit to their influence, are not always the same: varying, as they do, with the nature of the virus. There are some contagia which more particularly act upon the mucous membranes, others upon the connective tissues ; some require to be absorbed by the lymphatics, while others, again, operate immediately upon the mass of the blood, &c.

The ordinary channels are the skin, the digestive and respiratory organs, the mucous membranes in general, and, in fact, every living part.

When the vehicle is in a liquid form, and deposited on the skin, the germs may enter the organism by chance excoriations, or penetrating between the epidermic cells, and so finding their way to the vascular textures. Infection by the skin, however, must be rare ; the thickness of the epidermis, and the fact of its being covered with wool or hair, offering an obstacle to their admission. There can be no doubt, nevertheless, that the

more subtle contagia may obtain ingress through the orifices of the sebaceous and perspiratory ducts, especially where the skin is thin and scantily protected by hair; for the virus of acute Glanders applied to a part of this kind, has produced the disease; and some of the blood of an ox that had perished from Carbuncular fever, when rubbed into the skin of a horse, has induced a deadly form of Anthrax. The pressure and friction of diseased portions of animals which had succumbed to that malady, have likewise infected the skin of horses, and caused their death.

Renault has produced Glanders by merely applying the virus to the cutaneous surface; and Chauveau has also succeeded in this and other diseases, such as sheep Small-pox. But such inoculations, though practised upon regions where the skin is fine and the epidermis thin, do not always succeed; indeed, success is exceptional, and only follows repeated inunctions of the virulent matter—the rubbing, of course, irritating the part, and disposing it for absorption. When the skin is wounded or eroded, and friction is used in applying the virus, or if the latter is introduced beneath the epidermis by puncture, then its action is much more certain. Even when it is unbroken, but rendered swollen, soft, and pulpy by any cause whatever, the living particles may insinuate themselves into the minute spaces between the cells of the cuticle, and gradually approach the fine blood-vessels of the skin—for the poison must reach the blood.

The digestive canal has for a long time been believed to be a channel little favourable to the admission of disease germs into the system, and no doubt the gastric fluid is likely to modify or destroy them in special circumstances; but general experience, and recent experiments, have incontestibly proved that it does not offer constant immunity; indeed, Chauveau is strongly of opinion that a virus is even more certain and prompt in its action when introduced in this way. And there is no reason to doubt that contagious matters contained in the water or the food may readily make their way into the blood through the delicate membrane lining the stomach and intestines; or becoming lodged in the mucous follicles, may grow

and multiply there, and in this manner infect the circulating fluid. We know that certain entozoa can perfectly resist the action of the gastric fluid—indeed find a congenial home in the digestive organs; there is, therefore, no reason to suppose that some of the more virulent and tenacious of the contagia may not find an entrance into the body, through the medium of the aliment or fluids swallowed by an animal. Renault produced Glanders in healthy horses by giving them the virus of that disease in bolus; and Chauveau's experiments have likewise proved that this mode of access in Glanders is a very ready and efficient one. We also know from clinical observation, and from the experiments of Renault, Davaine, and others, that the flesh and blood of animals which have died from Anthracoid diseases, are most dangerous when eaten, and generally cause death: the stomach offering but a feeble, and only too frequently an ineffectual, resistance to the poison present in them.

Roche-Lubin and Belliol have produced ovine Variola, by causing sheep to swallow the crusts and matter obtained from the pustules of those affected with that disease; and Chauveau has demonstrated that Vaccinia can as surely be produced through the digestive canal, as by the injection of the virus into the blood-vessels. Recent experiments have also incontestibly shown that Tuberculosis is readily induced in animals by feeding them with tubercular matter.

The enzoötic cattle malady of the states of Illinois, Indiana, and Tennessee, known as "milk-sickness," engenders a poison which is found not only in the milk, butter, and cheese, but also in the flesh of the diseased beast; and these commodities, when consumed by people or animals, oftentimes induce a mortal disease.

It would appear, however, from recent experiments, that there is a difference not only with regard to the facility with which certain contagia can be absorbed by the stomach, but also as to the species in which it finds access by this channel. The canine species, for instance, is not liable to Glanders, but the disease can, in a fashion, be produced in it by inoculation—

the inoculated virus affecting the neighbouring glands, which become, as it were, a centre for its active proliferation; and this virus, when transferred to the equine species, will cause a most deadly form of the malady. Yet it has not been possible to communicate the disease to the dog by causing it to swallow the Glander virus. Variola also furnishes another notable example. The ox may be successfully inoculated by the direct insertion of the virus beneath the epidermis, and this inoculation is very frequently accompanied by a general reaction, which confers subsequent immunity. And yet the variolous matter, when administered by the mouth, or even injected into the blood-vessels, does not cause any eruption.

The air-passages, commencing at the nostrils and terminating in the air-cells of the lungs, undoubtedly afford most ready admission to disease germs. Comparatively thin and soft, exceedingly vascular and sensitive, covered only by a delicate layer of epithelium, and actively absorbent, they are ever open for the reception of whatever matters may be carried into them by the inspired air. Once the disease-producing particles are brought into contact with this very extensive and adhesive surface, they can easily and quickly find an entrance to the blood-vessels or lymphatic canals lying immediately beneath the epithelium of the membrane. We have abundant and incontrovertible evidence to prove that many contagious diseases are propagated by the breath, and their germs received by the lungs. The bovine Pleuro-pneumonia, Cattle-plague, Aphthous fever, sheep Small-pox, and other maladies can be so induced. Küchenmeister made a sheep breathe, during one hour, air which was made to traverse the shirt worn for twelve hours by a patient who was suffering from Small-pox. Five days afterwards the disease commenced, and by the eighth day a well-marked eruption of Variola was developed upon the sheep.

Glanders is another contagious disease, of a most fatal kind, which may be propagated through the air; and although direct inoculation is usually necessary for its transmission to man, in one case that fell under the observation of Dr. Beale; the evi-

dence that the fatal disease was communicated by the air was very strong indeed, if not perfectly conclusive.*

* The breathing apparatus of plants is not less vulnerable than that of animals. This is exemplified in an interesting series of experiments instituted by Dr. de Bary, an eminent German mycologist, having special reference to the parasitism of the "white rust" of plants. He made numerous observations to ascertain whether the spores, or the germinating tubes, entered by the roots of growing plants, and satisfied himself that they did not. Plants of garden-cress, mustard, and shepherd's purse had their roots immersed in water impregnated with zoöspores or ciliated cells of the fungus. After one or two days, though the surface of the roots was covered with zoöspores that had emitted their germinating tubes in all directions, none had penetrated, nor showed the least tendency to penetrate, the epidermis. Other plants were planted in flower-pots, and watered at the roots with water charged with zoöspores, and for two days the pots were left standing in the water similarly charged ; then the plants were removed, cultivated in the ordinary manner, grew up healthy, and gave no signs of the White rust. Care had been taken that neither stems nor leaves should come in contact with water containing zoöspores. If a drop of water thus charged is placed on the surface of a living leaf of the shepherd's-purse, for instance, left at rest for a few hours, and examined minutely at the end of that period, they will be found to have germinated. Let the epidermis be removed carefully, placed on a glass slide, and submitted to the microscope. Many zoöspores will be found to have produced from that point of their surface which is nearest to one of the stomata, or pores of the leaf, its slender tube, and to have thrust it through those openings, with the swollen extremity resting in the air-cavity situated beneath the pore. If many days, or even weeks, are allowed to pass, and the leaf is examined again, or another leaf similarly treated, and kept in a living and vigorous condition by remaining attached to the parent plant, no further change or advance will be observed, the germs will appear fresh, and still in the same condition. Hence, it is concluded that plants are not infected through the medium of their leaves. If the cotyledons, or seed-leaves, are watered with similarly impregnated water, a different result has been observed to take place. The germination of the tubes till their entrance at the stomata is the same ; but, having entered, the swollen extremity elongates, becomes branched, and takes all the appearance of mycelium. If the infected plant endures through the winter, the mycelium endures with it, to recommence vegetating in the spring.

The experiments which Dr. de Bary performed were all upon plants of the common garden-cress. It will be unnecessary to repeat all the details of these, as given in the memoir recently published on the subject ; but it will suffice to give a summary of results. In two series of plants

As Beale states, germs so minute as those of contagious diseases will enter the blood by other channels than the air-passages or alimentary canal. The mucous membrane covering the front of the eye—the conjunctiva—is soft and moist, and they could easily find a passage between the soft epithelial cells, and thus reach the blood. In some instances, it seems that the disease-germs gain access to lymphatic vessels, and grow and multiply there, causing abscess in some of the lymphatic glands. The blood is sometimes infected as well; while in other cases, in which there is serious inflammation of the lymphatic glands, it appears to escape contamination.

In some cases, the virus of a contagious malady, such as sheep Small-pox, is transmitted through the blood to the fœtus, and may thus insure the new-born animal against an attack of the

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cultivated at different periods from good seeds, one hundred and five plants which had not received the water impregnated with zoöspores upon their cotyledons vegetated without any indications of the parasite. Amongst the eighteen plants which were inoculated by watering the cotyledons, four only were not attacked by the parasite, and fourteen bore the "white rust." In six of these it did not extend beyond the cotyledons; in the others it also appeared on the stems and leaves.

From these experiments, it may be asserted that plants are not infected by spores of the parasite entering at the roots, or by their leaves, but that inoculation takes place through the medium of the cotyledons, or seed-leaves; that the agents in this inoculation are the zoöspores produced either from the conidia or the oöspores; that they do not enter the stomata or pores themselves, but thrust out a germinating tube, into the extremity of which the contents of the zoöspores pass; that when these tubes have entered the stomata of the cotyledons they branch and ramify, becoming a true mycelium, from which fruitful parasites are developed; that if a plant so infested lives through the winter, the parasite lives with it, to vegetate again in the spring.

"The immense number of zoöspores capable of being produced from a single infested plant, is almost beyond calculation. *It is easy for a million of conidia to be developed from such a plant, each producing from five to eight zoöspores, besides a large number of oöspores, each containing a hundred zoöspores.* It can scarcely be considered marvellous that the White rust should be so common on plants favourable to its development, the marvel being rather that any plant should escape." — *Microscopic Fungi*, p. 133.

disease ; and we know that certain contagious maladies in the human species—as Syphilis—are so transmitted.

Besides, it must not be forgotten that certain contagia—such as the equine disease, erroneously named "grease," and the sheep "foot-rot"—in order to produce their effect, must be deposited on a particular part ; with others the situation is of no moment ; while others, again, give rise to a more violent and extensive form of disease if they are introduced by certain determinate channels—such as the lungs—than by other modes of access—such as the skin. As an example of the latter, we might cite natural and inoculated ovine Small-pox.

14. *Incubation.*

When a virus has gained access to the body of an animal whose system is in a fit state to receive it, the reaction is not immediate, the commencement of infection not being marked by any objective manifestations ; and a certain lapse of time occurs between the moment of infection and the appearance of the first symptoms. This interval is designated the "period of incubation," "latency," or "latent stage" (*stadium latentis contagii*); it is variable in different, and even the same maladies. Very irregular in some, approximately fixed in others, it is not rigorously defined or constant in any—a circumstance greatly owing, perhaps, to the individual or race peculiarities, the degree of virulence to which the disease has attained, external and local influences, the nature of the disease, no less than to the mode in which the virulent element has attained access to the blood. The inoculation of some contagia will develop their special manifestations much more readily than if they found their way into the system by the ordinary natural channels. Thus, when Cattle-plague appears in healthy animals by infection, the period of incubation is somewhat uncertain, but is supposed to be from seven to twenty-one days ; when induced by inoculation, however, the limit of the latent stage would seem to be from four to eight days ; and so with other diseases.

The great variability of the latent stage of contagious

diseases is much more evident in some species than others, as well as in different maladies. This is well illustrated in Rabies, which may remain latent for from eight or nine days to as many months. Renault has seen it extend in an isolated dog for two hundred and sixty-nine days. With regard to the species, he also mentions that he has known an instance in which a rabid dog bit three other dogs, several sheep, two horses, and a child. One of these dogs became mad on the eighteenth day, and another on the forty-seventh. Two sheep became affected, one on the twenty-third, the other on the thirty-third day. One of the horses was seized on the twenty-first day. In the human species, the same irregularity has been noticed. Thus, Demanynk relates that three persons were bitten on the same day by a rabid dog; one was attacked with Hydrophobia on the thirty-second day, the second on the fifty-fourth, and the third in three months. But this subject will be fully treated when describing the different contagious maladies.

The interval between the introduction of a contagium may, therefore, vary from several days to as many weeks, or even months; during which the infected is, to all appearance, perfectly healthy, or, if sick, does not offer any of the characteristic symptoms of the disease.

There is no correlation between the rapidity with which the virus may be absorbed into the blood, and the strange phenomenon of incubation; though it has been imagined that it depended upon the time necessary to carry the poison into the circulation. This, however, has been repeatedly disproved.

Renault, from numerous experiments made on horses and sheep, has demonstrated that cauterization, thoroughly applied an hour after inoculation with the virus of acute Glanders, was ineffectual in preventing the development of the disease in the former; and when used freely to the wounds produced by inoculating sheep with Small-pox lymph, five minutes after the operation, it did not arrest the appearance of Variola in the latter.* Spinola further tested this subject,

* Reynal has, however, pointed out that Renault did not take into ac-

and found that amputation of the ears of sheep six, twelve, and twenty-four hours after the insertion of variolous matter in them, had no influence in retarding the evolution of the malady. Hausmann found that five minutes were sufficient for absorption. Faber also gives an instance of an ox whose tail was bitten by a rabid dog, and though the appendage was amputated within two hours, yet the animal afterwards died from Rabies. However brief the absorption period may be with some contagia, it does not appear to be so with others; for it is known that the Anthrax virus may be inoculated and remain in the wound for a variable period—several days—before it is finally absorbed. Cauterization has been successful in man in three or four days.

What is going on in the system during the period of incubation is not yet known. We have already noticed some of the theories as to the mode in which the viruliferous agents are supposed to develop themselves in the body. In all probability the disease-germs are being multiplied rapidly, after they have reached the superficial capillary vessels, and found their nourishment there; and this multiplication continues during the whole course of the disease, until the animal dies, or recovers—if its vital powers have been able to sustain the various phases of development of the poison. For the infecting element would seem to have not only its periods of existence well marked, but also to assume different phases or conditions, in accordance with some fixed law.

It may be that in some cases, the disease-germs having once located themselves, as, after inoculation, their multiplication is at first limited to the spot in which they are deposited, and that as they increase they throw their new particles into the circulation until they have become sufficiently numerous to produce the changes which characterize the disease that primarily developed them. It is even possible that in those virulent maladies which have long and irregular periods of in-

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count the likelihood of contagion having occurred in these experiments, beyond the inoculations, and asserts that when cauterization soon follows inoculation with Sheep-pox virus, the pustule will not appear.

cubation—such as Rabies—the germs may sometimes become encysted, and only resume their activity when excited by an accidental cause. "Just as a seed," says Beale, "may remain perfectly quiescent, but, nevertheless, in a living state, for a long period of time, without growing or giving any evidence of vitality, so there is reason to think that many kinds of bioplasm may remain in a living, but almost dormant, state in the system, ready to spring into active existence should the conditions favourable to their existence be brought about, and the pabulum for their nutrition be at hand . . . the development of the forms of disease characteristic of their presence being determined by the state of the system and the conditions to which it is exposed." Or it is equally probable that the germs are carried to the organs or textures they are ultimately to affect in a specific manner, by a special affinity, and are there reproduced.

It is not at all improbable that the period of latency is closely connected with, or dependent upon, the vitality or inherent power of multiplication of the germs of each particular malady.* For every disease has a particular period of incubation, which, of course, as has just been stated, varies widely in the different diseases: from the one to two days—as in splenic Apoplexy, to months—as in Glanders, and even years (if some cases are to be credited)—as noted in Rabies.

15. *Development and Progress of Disease.*

The commencement of the reactionary phenomena excited by some specific virus introduced into the body, announces the termination of the period of incubation. Usually, diseases manifest themselves in an indistinct manner at first, the initial symptoms being but slowly and insensibly developed; so that to the untutored eye they are frequently overlooked. This is more particularly the case with such phlegmatic creatures as cattle, in which the sensibility of the nervous system is less acute than in other of the domesticated animals.

* This apparently dormant state of a virus, and its capability of awakening to renewed vigour, is abundantly illustrated in the zoöspores and seeds of vegetables, and the hybernating condition of animals.

It must also be remarked that the symptoms of disease in animals are "objective"—not *subjective* and *objective*, as in man; while what may be termed the "precursory symptoms" are not generally sufficiently marked to allow an opinion to be given as to the nature of the disease.

In all virulent maladies, there are generally two orders of phenomena—those of a local and those of a general kind. The latter are indicated by elevation of temperature—a very early alteration of the normal condition—and quickened pulse, due to increased circulation; while the first may be only a limited inflammation caused by the virulent elements. This local affection may be readily remedied in some instances (as in malignant Carbuncle and Glossanthrax), but most frequently it affects the constitution generally, and more or less promptly. When the malady begins to manifest itself, the functional disturbance may appear exceedingly slight; but, according to the nature of the factor and the effects it induces, the symptoms become more developed and unmistakable as the disease progresses and passes through its different stages.

The disturbances, as has just been stated, are generally local and general; most frequently the latter are most marked, but even then the pathological changes will often be found localized in organs and textures, betraying themselves by congestions, inflammations, ulcerations, eruptions, or other appearances.

These effects might certainly be induced by various causes, looking at them apart from other features accompanying the disease; but when we take into consideration the entire catalogue of symptoms, their order, and the particular physiognomy they bear, we shall find a special and distinctive character impressed upon them which cannot be mistaken, and which differs widely from the reactions induced by other agents.

Of course, we must make allowance for the modifications which individual predisposition and other influences may produce upon the specific cause, as they will in nearly every case alter, more or less, the minor symptoms; though they

cannot change or obscure the chief, or distinctive, organic and functional derangements.

The specific action of these contagia is an inevitable consequence of their potent and unvarying individuality: an attribute they never lose. Indeed, so wonderfully do they preserve this individuality, or unicity, that two different contagia conveyed into the system of one individual will most certainly develop their effects simultaneously or successively, according to their nature—the one lying dormant while the other is actively exercising its powers, to rouse up when its time comes; or, if both are acting at the same time, to produce each its characteristic symptoms without confusion or restraint. Thus, during the Cattle-plague in this country in 1865 and 1866, it was not very unusual to see cattle attacked simultaneously with that malady and Aphthous fever or contagious Pleuro-pneumonia: a circumstance also witnessed by Jessen, who has likewise observed the Carbuncular fever and Cattle-plague present at one time in the same animal. The Variolous disease of the sheep and cow has been frequently noticed as affecting these creatures while they were suffering from Rinderpest; and Reynal has seen a sheep affected with Rabies while suffering from inoculated Variola.

As has been said, the first symptoms of disease are sometimes local, appearing at the part where the contagium has been introduced, particularly if inoculated: sheep Small-pox, and Rabies not unfrequently, ; or they are general, if from the very commencement there has been constitutional disturbance, as in Anthrax fever and Cattle-plague. The local alterations are usually betrayed by pain, redness, and swelling, while the general disturbance is marked by a more or less intense fever. In the course of the disease, there are often joined to the local symptoms those of general trouble; and if the first indications of the affection are a febrile reaction, there soon occurs a depot or specific localization in a particular region of the body, and the signs of fever disappear. In those maladies which are purely contagious, the local alterations present certain characteristic forms, particularly in the eruptive

diseases, and secondary disturbance in other regions may be the result.

16. *Period of Virulency.*

It is not yet quite decided in what stage of these maladies the contagiousness is most intense; but it is not improbable that during the period of incubation, and in certain cases towards the termination of the disease, it is feeblest, while at the crisis it is most potent. Geert Reindeers and Jessen have shown that inoculation with matter from an animal in the convalescent stage of Cattle-plague will not produce the disease.

It is still a matter for elucidation how the local disturbance in a contagious malady extends to the other organs and tissues of the body. In some cases the local morbid process extends in the textures primarily affected, and in those which are in sympathy with them; in many instances this extension takes place through the medium of the blood, which experiences certain modifications, becoming an infecting or contagiferous agent: as in Glanders, Rabies, Anthrax, &c.

Beale remarks that in every form of contagious disease, and during every period of its existence, the circulation through the capillary blood-vessels is affected; indeed, that the essential phenomena of each special malady are due to changes in the quantity and quality of the contents of these vessels. If recovery from the malady is rapid and complete, the capillary changes induced by the disease are slight. If the disease terminates in death, the fatal result is occasioned by irreparable damage in and around the capillary vessels themselves, or it is due to secondary changes in the tissues induced thereby. The character of the eruption is determined mainly, and in some cases entirely, by the abnormal state of the capillary circulation; and even in those instances in which local alterations in vascular tension are unquestionably associated with nervous disturbance, this is often induced indirectly by a primary change in the capillary circulation, by which the afferent nerve-fibres passing to the ganglia are influenced. Disturbance consequently occurs in the ganglion, and the central

variation excited in the intensity of the current is conducted along the efferent vaso-motor arterial nerves.

In all the cases of contagious disease which Beale examined, he found the same kind of living germinal or "bioplastic" matter already described, in the capillary vessels of many of the affected tissues of the body. In some parts the vessels appeared to be quite filled with a granular, and more or less transparent, material, the atoms of which were exceedingly minute, and when fresh could be stained by the carmine fluid.

The most virulent and fatal fevers excited by the introduction of poisonous disease-germs into the organism, differ from the simple feverish condition, according to Beale, only in degree, and in the immediate exciting cause of the early changes. Congestion in many of the surface capillary vessels is invariable in all fevers. Upon local or general dilatation of the small arteries and capillaries of the cutaneous surface, the general redness, spots, or rashes characterizing various kinds of fever, depend. In some cases the dilatation and congestion of the capillaries pass on to actual rupture and extravasation of blood, and little ecchymoses result. In others serum, containing much red colouring matter of the blood, permeates the walls of the vessels, and infiltrates the neighbouring tissues. In all febrile states, the heart cannot drive the blood through the obstructed vessels fast enough to carry off the animal heat which is developed. The temperature of the whole body therefore rises, and the action of the various organs which are adapted to work perfectly at one fixed temperature is deranged.

In contagious fevers, similar phenomena are observed, and are caused in the same manner; but the bioplasm matter (disease-germs) which generates has a definite rate of multiplication of its own. It goes on increasing for a time, and from its increase serious complications may result. Numbers of the germs produced may pass through the capillary walls into the tissues around, and many escape from the excreting surfaces into air and water, and thus the scourge is spread far and wide. When this has happened under favourable circumstances, the process stops. Products resulting from the death

and decay of the specific contagious germinal matter which yet remain, are removed by the increased activity of the organs of excretion, and health is gradually restored. If, on the other hand, the changes have proceeded to a degree sufficient to obstruct the capillary circulation over a considerable portion of the body, or throughout the greater part of one or more organs, the integrity of which is necessary to life, recovery is no longer possible, and death must result. Complete interruption, or sudden cessation of the circulation, from any cause whatever, may produce almost instant death.

Any local disturbance of the capillary circulation gives rise to various phenomena, according to the seat of the change. In certain fevers, the disease-germs may increase in the blood to such an extent during the period of incubation, that the earliest symptoms may be followed by death in a very few hours. In some of these terribly fatal cases, it is possible that the capillaries of the nerve-centres may be the seat of obstructed circulation; in others the fatal results may be occasioned by rapid chemical changes set up in the blood, and an indirect effect upon the nerve-centres produced through the nerve-fibres distributed to the capillaries; but in some instances, the state of the capillary circulation in all parts of the body justifies the inference, that the fatal result is actually due to the cessation of the circulation in the obstructed capillary vessels distributed everywhere.

17. *Course of Contagious Diseases.*

The course of a contagious disease is generally more regular, and its stages better marked, than those of other diseases; and it is nearly always observed that the intensity and fatality of such a malady is greatest during the first half of an epizoöty; towards the middle the cases are most numerous; but after that period they diminish in number and the malady in intensity. Indeed, this feature appears to be dependent upon some peculiarity in the constitution of the virus. In our inquiries into the nature of epizoötic diseases, it was observed that some had their period of growth, when they were beginning to spread; that they soon became stronger and more devastating,

until they had attained all their virulency and power of transmissibility; that then they sensibly began to modify their disastrous effects, and so mild would the attacks eventually become, that infallible cures would spring up on every side. This cessation must be due to the limit to which the virulent element can be regenerated; and it seems that this limit is often reached before all the animals in a certain region have been infected—unless the constitutions of those which escape have proved refractory. The poison of Cattle-plague and of Rabies in the dog, as well as the virulent products of other diseases, gradually lose their potency in this way; the periods of incubation becoming longer, and the numbers attacked fewer and less seriously affected.

18. *Protection.*

As a general rule, all the contagious diseases accompanied by fever, are held to confer a kind of protection—temporary or permanent. In the former case, a certain period must elapse after the first attack, before the body is again susceptible. Aphthous fever, for instance, is followed by temporary immunity—though the interval has not been exactly ascertained. I know of instances, however, in which animals have been attacked twice in one year. The best marked examples of permanent protection are to be found in Cattle-plague, contagious Pleuro-pneumonia, Variola ovina, and the African Horse-sickness.

In some cases, the introduction of a virus by a very limited channel, as by inoculation, will produce in the healthy animal a mild form of the disease, which will nevertheless protect it from another attack (Sheep-pox and contagious Pleuro-pneumonia in animals, for instance, and vaccination in man).

But an attack of one contagious malady, as has been mentioned, does not avert the invasion of another, in the lower animals at least; Pleuro-pneumonia, for instance, does not preserve a cow from being subsequently affected with Cattle-plague or Aphthous fever.

The manner in which this protection is brought about is as yet unknown, nor is it likely that it will receive much elucida-

tion until the nature and *modus operandi* of disease-germs have been more thoroughly investigated. All we know of the process may be summed up in the words of Beale. A living disease-germ of a certain kind is introduced into a healthy organism. It grows and multiplies freely, and in the process causes derangement of most of the normal phenomena, bringing about a state of disease more or less serious. After a definite time, the countless multitudes of germs cease to multiply further. Many of them die, and the products of their decay are eliminated from the body; while many may escape in a living state from the organism, and gain access to other living beings. But the remarkable fact is, that after an organism has been the seat of these changes, its state is everywhere completely altered; inasmuch as similar disease-germs, and in some instances germs of another kind (in the human species), will no longer grow and multiply. The living particles may get into the blood, or they may be forced into it, but they will not give rise to disease. The organism which has already been diseased and has recovered, may be afterwards inoculated to any extent, but the living particles will not grow and multiply in it. They will die; or if they do not perish, they remain in the body without inducing any change.

The organism which may have been scarcely deranged, or nearly destroyed by the first invasion, is by that operation rendered proof against a second attack; but this protection is not, at least in many cases, necessarily permanent.

After the lapse of a certain period of time, in some diseases further change occurs, and the organism again becomes fitted for the growth and multiplication of the same kind of disease-germs—in fact, susceptible to another attack. This period of protection varies in duration, but is probably pretty constant for each particular kind of disease-germ.

It has been supposed that protection results from changes occurring in the blood only, without any alterations having been necessarily effected in the solid tissues. All contagious fevers are, indeed, essentially "blood diseases;" so that it might be inferred that protection is due to the removal or destruction of some peculiar element in that fluid by the

germs, which is never reproduced in the case of non-recurring diseases, and only after a time in those maladies which may be repeated.

19. *Escape of the Disease-Germs from the Body.*

During life, when a transmissible disease has fairly attacked an animal, the disease-germs may be developed and multiplied throughout the whole body, or they may only be elaborated in certain glands, localized in particular situations, or textures, and thrown out with accidental secretions (contagious "foot-rot" of sheep, the so-called "grease" of horses). But usually solids, fluids, exhalations, secretions, and excretions are impregnated with the virulent element in many contagious diseases: everything, even the fœtus *in utero*, seems to be saturated, and nothing animate or inanimate in the vicinity of the creature can escape contamination. Such a degree of virulence we find in Cattle-plague.

There is nothing to prevent the germs escaping freely from the body in such contagions, as they abound everywhere; and there can be no doubt that a high temperature of the body, and keeping animals suffering from fevers, especially of the exanthematous class, in hot, close dwellings, greatly favours their increase and escape.

It is evidently of the greatest importance to study not only the organs, textures, or fluids in which the contagia of diseases are elaborated, but also the channels by which they escape from the body, and the media which convey them. On this knowledge greatly depends the success attending preventive and suppressive measures. Each contagious disease, as we have seen, and as will be abundantly exemplified in the third part of this work, has special and characteristic phenomena, and certain parts of the body are more particularly affected than others; these are generally the places where the poison is chiefly located, or where it exists most abundantly, and possesses the greatest amount of virulency; and from these it is thrown off in largest quantity. The destruction of the contagia should therefore be commenced at these parts, when they are accessible to disinfecting agents; or at least to the

media which carry them, immediately after their escape from the body.

20. *Vitality of the Disease-Germs.*

If there is one fact better established than another, it is that the death of an animal from a contagious disease is not always death to the virulent principle which has been elaborated in its body. Often this will retain its vitality and power of reproduction for a long time after the creature has ceased to live, or after the contagium has left the animal body; though, as it is organic matter, it must submit to the laws which govern the stability of such compounds, and when it is placed in conditions favourable to decomposition, it must yield to this disintegrating process. When these conditions are absent, however, it is truly wonderful the length of time it will often remain effective.

The capacity of certain contagia for resisting death, due to some inherent power, and not altogether, it would appear, to their chemical composition, varies much; some being capable of living for weeks or months away from the fluids of the body, while others die within a very short time after their removal from the region in which they were elaborated. So that any body charged with the contagium of some diseases will possess the power of infecting, even when all trace of the vehicle has disappeared; some contagia, indeed, would seem to exist when putrefaction has destroyed their "bearer." Camper and Vic d'Azyr tell us that they have been able to inoculate healthy cattle successfully with the virus taken from an ox that had died of Cattle-plague, and been buried for three months. Weiss has used the virus of Cattle-plague after keeping it for six years, and produced the disease; while Opitz states that the dead body of a cow infected others with this malady after nineteen years! Hering says the virus will maintain its tenacity for six years; and many instances are recorded in which animals had been buried for three, four, and five months, and infected herds that grazed over them. Haubner reports that hay kept in a loft above diseased

cattle, contaminated healthy stock four months afterwards.*

Doubts have been expressed, and reasonably I think, as to the value to be placed upon the long periods mentioned.

Adami has proved by experiments, that three days' exposure to the open air will render the virus of Cattle-plague impotent. And in 1853, a commission was appointed to proceed to Odessa, for the purpose of investigating the value of inoculation as a preventive of that disease. The virus was carefully collected; everything was done that is usually required to ensure the preservation of such mysterious fluids; and yet, when seven oxen were inoculated at Dorpat six months afterwards, there was no result. If this can be received as trustworthy evidence, it shows a curious instability in the most subtle and virulent of all animal poisons—except perhaps that of Rabies. Rempach and Sergejew, however, have proved that matter from Cattle-plague animals, when kept for months, and even more than a year, has not lost its virulency. Of course, everything depends upon the way in which it is preserved. It may be mentioned, however, with regard to the virus of Cattle-plague, that weather has but little influence upon it; and that it undoubtedly maintains its vitality for weeks, and even months in some circumstances, when deposited on certain materials in particular situations.

The tenacity of some disease-germs is unaccountable. Men who are obliged to handle and work among the hair and hides

* Ampach states that during the winter of 1810, Cattle-plague appeared at Spumberg, near Salzburg, among the cattle of four peasants who kept a relay post. One of them lost fourteen animals; in four months he purchased eleven more, and put them in the stable, which had been thoroughly disinfected; but he fed them on hay that had been kept packed up in the loft and was still contaminated with the emanations from the sick, though it had been exposed all the time to the cold winter wind; the new cattle all died. In January, another of these men carried away the manure of the diseased cattle, and deposited it in the fields, but when he commenced to plough it into the ground with oxen in April, the latter were infected by it and perished. A farmer introduced this malady among his stock after handling skin which had been dried and exposed to the air for four months, but were wetted again to be tanned.—"Praktische Lehre v. d. Heerde Krankheiten, &c., Haussäugethiere." Pesth, 1819.

of cattle and horses sent to Europe from the prairies of South America, are not unfrequently attacked by Carbuncular fever; even certain chemical agencies cannot destroy this virus, as Malignant pustule is sometimes produced in man by tanned skins derived from animals which have died of Anthrax. Gerlach speaks of the virus of splenic Apoplexy infecting three years after the death of the animal.

Indeed, there is reason to believe that some of these poisons not only live and multiply in fluids different to any in the body, but that during the course of such growth and multiplication they acquire more virulent properties.

Vaccine matter will retain its efficacy for two years; and the lymph of Sheep-pox is endowed with strong preservative qualities. Haubner has testified that that disease and bovine Pleuro-pneumonia have been induced by inhabiting places tenanted by sick animals three to five months previously.

The virus of Rabies is believed by some authorities to be very tenacious of its potency (Röll), and by others to be very evanescent (Haubner). I have given proofs for and against this tenacity here, and in my treatise on "Rabies and Hydrophobia," and some of these will be noticed in the third section of the present work.

It is certain that some contagia maintain their biolytic faculty for an unaccountably long period under certain circumstances; while others are readily destroyed by desiccation, the action of the air and light, or an elevated temperature. In those which are so tenacious of vitality, it is probable that the germs are enclosed in some matter which favours their continued existence, and keeps them only partially dried; and if we admit that the viruliferous elements are a degraded form of organized matter or bioplasm, we will not have much difficulty, judging by analogy, in concluding that they may possess peculiar powers of resistance to the action of external influences.* We will again refer to the vitality of contagia when

* The lower forms of organized creatures—such as *amœba* and *rotifers*—may, as is well known, be dried, and retain their vitality; but they are not thoroughly dried, as complete desiccation must destroy life. With regard to the vitality of low forms of vegetable life there is abundant evidence.

treating of the different maladies to which they belong. In the meantime, it may be sufficient to mention that the question of vitality of virus is of great moment in a sanitary point of view, as on it preventive and suppressive measures must be largely based. With regard to temperature, it may be noted that vaccine matter, which, when well preserved, will retain its activity for twenty or thirty years, or even longer, is rendered inert by a temperature of 140° Fahr., and that the virus of Scarlet fever loses its potency after being exposed to a heat of 204° Fahr. Some of the lower organisms, however (as the *bacteroids*), appear to be endowed with a greater degree of vitality when exposed to high temperatures. The common vibrio, according to Calvert, withstands a heat of nearly 300°, and the black vibrio, which appears to be a very Salamander among animalcules, is not killed by a temperature of less than 400° Fahr. In Lex's experiments, he found that a temperature of 262·6° Fahr. did not kill bacteroid bodies, and half an hour's boiling did not abolish their vital movements. Strong acid and caustic alkalies even appear to do them little harm. Bastian, however, asserts that a brief exposure to a temperature of 158° Fahr., either killed their germs or destroyed their power of reproduction. And the Académie des Sciences of Paris, after a long investigation, came to the conclusion that none of the lower forms of organic life or their germs could resist in air a temperature of 266°, and in liquids 230° Fahr. In most cases a temperature of 180°. Fahr. is sufficient to destroy infusorial life; for that will coagulate albumen, of which they are composed.

SEPTIC INFECTION.

Besides the contagia alluded to, there is another class of infective bodies whose existence is well ascertained, and which are not without their special attributes in the production of

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On the other hand, as Parkes has pointed out, certain fungi in water are destroyed by a comparatively low heat. Indeed, we find the same diversity in the vitality of vegetable productions that we do in different contagia; showing that the latter have an existence independent of the organisms which developed them.

disease ; but the maladies to which they give rise are, so far as present researches extend, of a different kind to those due to the disease-germs we have been describing, though they may nevertheless complicate them. Indeed, it may be anticipated that further investigation will demonstrate, that between the true virulent diseases and those now under consideration, there is the closest relationship, if not absolute identity, in the manner in which they are produced.

These affections have been named *septic* or *septicoid*, and the general morbid condition upon which they depend is designated *septicæmia* or *septichæmia*. In the present state of our knowledge, this condition consists in an alteration of the blood or of some of its constituents, and the presence in that fluid of very minute living bodies or proto-organisms named *microzymes*, *bacteria* or *bacteridia*, or *vibrionæ*, which multiply very quickly. Through the researches of Delafond, Fuchs, Brauell, Rawitsch, Davaine, and others, it appears to be fully ascertained that the septic properties of the blood and other fluids are connected with the presence of these organisms, which exercise a decomposing or fermentative influence, and produce a kind of poisoning more or less serious, according to the species of animal, and individual circumstances. This condition of the nutritive fluids may arise spontaneously from the action of external causes, but can be transmitted to every species of creature, apparently, by inoculation or other means. Even what might be termed innocuous matter—such as pus—when in a state of change, and when this change is accompanied by the formation of bacteridia, will, when introduced into healthy creatures, sometimes induce in the most prompt manner a fatal result. The disease which we have termed "anthrax," with its multiform characters, is a malady in which we have this condition of the fluids, and should really be classed among the septicoid diseases. We also have discharges, producing symptoms of purulent or septic infection, either generally or locally, when they chance to be absorbed—as in the generative apparatus of male bovines, after they have had intercourse with females affected with unhealthy discharges ; after wounds with cutting instruments, by which putrefying matters gain ac-

cess to the blood, or by the teeth or claws of carnivorous animals which have shortly before been devouring putrid flesh. We need not allude further to this matter than to state that we have no certain evidence that there is a "volatile" contagium in these maladies, and that direct inoculation by a wound, or access through an abraded surface or thin membrane, is necessary to produce them.

When the matter is introduced by the skin—as with Anthrax blood—we not unfrequently have local disturbance in the form of an abscess or Malignant pustule; but when injected directly into the blood or into a serous cavity, the symptoms and results of general blood-poisoning are observed very promptly, according to the species of animal.* Among the conditions most favourable, and indeed necessary, for the production of septicæmia, is heat. This may explain the frequency of Anthrax and other septic maladies during hot weather.†

* Some of Davaine's experiments are very interesting, particularly as showing the great potency of septicæmic blood. In one of these experiments six watch-glasses were placed on a table; into the first of these a hundred drops of water were placed, and to these was added one drop of blood from a septicæmic rabbit; the whole was stirred so as to produce a dilution of one hundredth. One drop of this was placed in the second glass containing a hundred drops of water, and a dilution of one ten-thousandth produced. In the third glass, a drop from the second gave a dilution of one millionth. In the fourth glass, a drop of the third dilution added to the hundred drops of water produced a dilution of one hundred millionth. In the fifth glass, similarly treated, there was a dilution of one ten thousand millionth, and in the sixth glass a drop of the dilution gave a trillionth part. Four rabbits were then inoculated respectively with the first, second, third, and fourth dilutions; a horse with the second, and a guinea-pig with the first. Next day all the rabbits were dead, the guinea-pig was taken ill but recovered, and the horse remained well.

Dogs are also readily killed with the septicæmic virus derived from the rabbit. Chauveau destroyed a horse by injecting six drops of pus, rich in bacteria, beneath its skin.

† It would be interesting to learn whether the stings of certain insects produce septicæmia in particular animals. The symptoms described are frequently not unlike those of septic diseases. See Bruce's "Travels" for descriptions of the effects produced by the *Tsaltsalya* fly; Burton's "Lake Regions of Central Africa," vol. ii. p. 18, for those of a fly in Central East Africa; and Livingstone's and Chapman's "Travels in South Africa," for those of the *Tsetse*.

PARASITIC INFECTION.

Among the contagious diseases is another category due to the presence of animal or vegetable organisms or parasites, living upon or within the bodies of animals, and which multiply by direct or alternate generation. As a rule they produce their effects by the local irritation, general disorder, or destruction of texture they set up. Many of them are microscopic; others are so exceedingly minute that even this instrument can scarcely reveal their presence, while others are visible to the unaided eye. If few in number, very minute, and little aggressive, or if they do not infest organs or fluids of much importance in the economy, they may cause little disturbance of health; though when the converse is the case, they may inflict serious injury—and even death. Though not, strictly speaking, coming within the scope of real contagious affections, yet as some of them are transmissible from one animal to another of the same, or even of different species, their consideration cannot be omitted in a work of this description.

The "animate contagia," as they have been termed, which are due to the presence of animalcules, may inhabit the interior or exterior of the body, or infest the different tissues. From the earliest times there has prevailed an idea that all contagia consisted of animalcules—large or extremely minute, and the microscope has certainly proved that the idea had at least a good foundation. Gradually the number of parasites discovered has been increasing, and nearly every year adds to the long list—particularly in the helminth class; while our knowledge of their nature, and their mode of origin and transmission, is being rapidly perfected. Those animal parasites which are found on the surface of the body are named *Epizoa*—such are the *sarcoptes* of scabies, cutaneous vermin of all kinds, &c., while those inhabiting the interior of the body are designated *entozoa*—such are the different *cestoid*, *nematoid*, and other kinds of worms, as well as the larvæ of the various kinds of insects.

It is unnecessary here to give a detailed notice of those

which more particularly concern us, as they will be alluded to when we come to treat of the special diseases they occasion, and which brings them within the scope of the sanitary pathologist. It will, therefore, be sufficient to state that the horse, sheep, cow, dog, and pig—all the domesticated animals, in fact, as well as undomesticated—are liable to be made the hosts of various kinds of parasites, which may, under certain circumstances, deteriorate health to such a degree as to produce serious, and perhaps incurable, disease. Some are peculiar to one kind of animal, some to another; some may be successfully introduced into the bodies of all animals indifferently; while they differ from one another sometimes to the most wonderful degree, not only as to their predilection for certain organs, tissues, or fluids, and the various metamorphoses they undergo, but also with regard to their vitality. In some this is highly developed and easily destroyed, while in others it is quite marvellous for its tenacity. For example, the pig is sometimes infested with the *Cysticercus cellulosus*, an entozoön which produces a severe form of disease, but whose destruction can only be accomplished by thorough salting and smoking, and a temperature of 212°. The *Trichina spiralis* is another entozoön bred in the body of that and some other animals; its vitality is so subtle and intense, that an extreme degree of cold, a high degree of heat (212°), or even the putrefaction of the animal's flesh in which the parasite has taken up its abode, will not always destroy it, according to some authorities. And horses have been affected with mange through wearing woollen coverings which have been thrown aside for four years.

Vegetable productions are also active agents in causing disease. Those which more particularly operate on the exterior of the body are designated *Epiphytes* (from ἐπί upon, and φυτὸν a plant); such are *Tricophyton*, *Achorion*, *Microsporon*, &c., while those found in the interior of creatures are named *Entophytes* (from ἐντός within, and φυτὸν a plant); in this class we have the *Oidium* of the "thrush" of young creatures (and, it is supposed, of the Foot-and-mouth-disease), the *Botrytis*, &c.

We have already noticed the effect of blights in vegetation

as predisposing to, or directly producing, extensive and formidable epizoöties. The rust, smut, mildew, and mould of the vegetable kingdom are only so many microscopic fungi, which, existing at all times in the form of exceedingly minute germs, may be propagated there, and when favourable circumstances occur—chiefly of a climatic kind—and the plants offer them a suitable nidus, they attach themselves to their textures, become rapidly developed, and cause disease and death to the plants. By the consequent scarcity of these, animals may suffer from famine and die of starvation; the fungoid growths may be poisonous in themselves; or their sporules or other fructifying agents may gain admission to the body and produce particular maladies. We have already given examples of such occurrences.

The *Uredo rubrigo* has been found in an active stage of growth in the lungs of animals; and some of the most obstinate and so-called contagious forms of disease in the lower creatures, and even in mankind, are due to the action of minute fungi.

Recent experiments have demonstrated that certain cryptogams, when inoculated in mankind or animals, induce a peculiar form of disease. Thus the mucedines of "thrush" (*aphthæ* of young animals) propagate the disease with a wonderful rapidity. Reynal has seen the malady spread quickly among groups of lambs after one has been affected; and by merely depositing the *oidium albicans* on the lining membrane of the mouth, he has been able to propagate it easily, particularly if there was much acidity present in that cavity. And Collin reports that he has had to treat, medically, people who, in working among vines covered with this vegetable parasite, became affected with a Vesicular eruption, then Gangrenous inflammation, severe constitutional disturbance, and the appearance of the *oidium albicans* on the membrane of the mouth.

The atmosphere, as has already been pointed out, always contains numberless infusoriæ which are similarly developed when they find a suitable abode; but we know not how their growing vegetable and infusorial germs may re-act on the

solids and fluids of the animal body, or in how far their influences may differ. Certain of them only infest the outer surface of the body, where they give rise to irritation and its consequences ; and others (such as *Aspergillus*), gaining admission to internal membranes and organs, are supposed to produce specific results. The theory of Hallier, utilizing the laws of alternate generation and of digenesis in the reproduction of certain cryptogamic vegetations, is an endeavour to establish the dictum that "all virulent agents are nothing more than an allotropic condition of various mucedines or moulds, which only arrive at their complete development without the body ; though in it they multiply in the form of excessively fine granules designated *Micrococci*." Every virulent malady has been, in conformity with this theory, set down as depending upon the presence of fungi or *Micrococci*—each epidemic or epizoötic disease owing its origin to a different fungus ; and though there are a number of facts which tend on the whole to support the supposition, yet so much doubt has been cast upon the startling assertions made in its favour, that further investigation is necessary before anything like implicit confidence can be placed upon the value of the recorded observations.

Then there is the theory with regard to the part played by *microzymes*—minute bodies supposed to be potent in the production of fermentation, but whether of a vegetable or animal nature has not yet been decided ; though if the term applies to the exceedingly minute granules which are found in the healthy and diseased body, then it agrees with what Beale and Chauveau have observed.

It must be remembered that investigations conducted with the view of settling what is debatable in reference to these *micrococci* and *microzymes*, are surrounded with a multitude of difficulties, not the least of which are those that likewise haunt researches into the problem of spontaneous generation. Minute bodies, of a similar or identical character, swarm in a short time in infusions or fluids containing organic matter, making their appearance where no previous sporules can be supposed to have had access. These particles require the highest powers of the microscope to distinguish them ; and they exist in

such multitudes, and are so difficult to isolate, that to observe the consecutive development of any single atom is almost impossible. There is also the risk of sporules being introduced from without, as well as the possibility of new elements being produced by spontaneous generation (if such a power exists), that there may well be doubts expressed as to the absolute trustworthiness of the published experiments and observations.

The observations of Pasteur and Davaine, however, may be accepted as throwing some light on this subject, and more particularly with reference to the fermentation theory and the infusorial germs. The first-named authority is of opinion that during the development of these germs, they induce those chemical transformations which are usually referred to the action of oxygen; that some of the infusorial ferments—among which may be named the *Bactcridia*, already alluded to in speaking of septicæmia—develop only in oxygen; while another class, such as the *vibrios*, undergo their transformations when that gas is absent. Each requires an organic medium for its evolution, and in this it either sets up, or is accessory to, those fermentations or putrefactive phenomena which occur under certain conditions in organic compounds. Different changes, too, are brought about or accelerated by different germs. The butyric acid fermentation is due to an organism that cannot live in air—a *vibrio;* the alcoholic fermentations to a *torula;* the acetous fermentation to the *mycoderma aceti*, and so on.

The number of these germs in the air depends on its purity; the more it is polluted by organic matter, the more promptly and speedily do fermentizible compounds undergo change. Bacteria, or bacteridia, which are made up of excessively small and fine, straight, round, free filaments, abound in the air, and absorb oxygen very rapidly, have been found, as already stated, in the blood of animals which have died of Anthrax, though they are not present in healthy blood. It has also been noted that it is supposed to be owing to their presence in certain fluids that these produce septicæmia when transferred to the blood of healthy creatures. As an evidence of the vital tenacity of these germs, it has been shown that

liquor potassæ and sulphuric acid do not destroy them, while many can even withstand a temperature of 240 degrees. We have already given another instance in the case of dried, and even tanned hides producing Anthrax.

THE IDENTIFICATION OF CONTAGIOUS DISEASES.

It is nearly always a matter of the utmost importance to ascertain whether a disease, the nature of which is doubtful, is or is not contagious; as on our being able to decide this will depend the necessity for resorting to sanitary measures to check its extension, by destroying the contagium to which that extension will be due. To distinguish a contagious from a non-contagious disease is not, in some cases, a difficult matter; in others, it is far from easy, particularly if a direct demonstration be required. The most certain criterion is, undoubtedly, *inoculation*—an operation readily performed by taking from the animal suffering from the suspicious disease any fluid or product of secretion most likely to contain the viruliferous principle, and introducing it, by a wound or otherwise, into the body of a healthy creature of the same species, at a part where it is most certain to be quickly absorbed. Should the disease be contagious, then the inoculated animal will in due course become affected with the malady. In this way, inoculation is a certain test in a number of diseases, such as Cattle-plague, Variola, Glanders and Farcy, Anthrax, Rabies, &c., as well as in certain parasitic maladies, when the parasites can be so transferred. But in other diseases whose contagiousness cannot be denied, this ready test gives no result, because it would appear that it does not fulfil all the conditions which render natural infection possible. As an example, we may instance the contagious Pleuro-pneumonia of cattle, in which inoculation does not produce the peculiar lung alterations which form such a marked feature in the malady.

When inoculation cannot be practised, or when, from certain circumstances, it may be unadvisable, we still have the proofs which experience offers with regard to the presence of a contagium. If, for instance, we find that animals are attacked by certain diseases—such as Cattle-plague, Foot-and-

mouth disease, Scabies, Glanders, Variola, &c.—only after they have been in *direct contact* with a sick animal, or with some vehicle of contagion, and also that isolation or sequestration rigidily practised when a disease prevails, protects healthy animals, then we may presume that contagion exists. There is yet more certainty in considering the disease as contagious if, after the introduction of a diseased animal among a number of healthy ones, the same disease afterwards manifests itself first among those which have had closest and most frequent communication with it, and subsequently extends to the others.

The mode in which the disease is propagated may also furnish a valuable index to its character in this respect. Supposing, for instance, that the affection only follows the routes of animal-traffic, and can be traced to markets and fairs, and from these as from so many centres, radiating in every direction, and travelling from farm to farm or from stable to stable, being carried by animals or people who have had direct or indirect contact with the diseased—then there can be little doubt as to what the extension is due. Or if a disease is known to exist in a particular country in an epizoötic manner, and appears suddenly in another, its appearance coinciding with the importation of animals from that country; if the first attacked after the importation are those which have been in communication with the new arrivals, frequenting the same pastures, inhabiting the same stables; and if the disease subsequently spreads from the infected localities to others by evident means—sparing other animals which have not been so exposed—then there is a great, if not an absolute, certainty that the malady is contagious.

Should further proof be necessary, and the affection belong to the non-inoculable class, then placing a healthy alongside a sick animal may be resorted to, in order that infection may take place in a natural manner. Or, in certain cases, we may transport the diseased creatures to a locality where the malady has not yet manifested itself, put them into direct communication with healthy ones of the same species, and practise inoculations, &c. If, then, the latter become affected, while those

in the locality which have not been so exposed escape, it may be safely concluded that it is a contagious disease.

In this way did Professor Lafosse—in concert with MM. Yvart, inspector-general of the French veterinary schools, and Prince, director of the Toulouse veterinary school—demonstrate the contagiousness of the so-called "venereal disease" of horses—a curious malady, which will be described hereafter. It had been observed at the stud establishment at Tarbes, that this affection only attacked those animals which had been sexually in contact with individuals already infected; but the opponents of contagion only saw in this the results of an epizoötic influence. To settle the question, the Tarbes stallions were sent to Toulouse, where the disease was unknown; they were put to artillery and hussar mares, which were perfectly healthy, and several of these became sick, while some even died. At the same time, no other mares or stallions in the *arrondissement* of Toulouse showed the faintest trace of the malady. To give a still stronger proof of its contagiousness, two stallions from the depot at Villeneuve-d'Agen were brought to Toulouse, where they were put to mares which had been contaminated by the Tarbes stallions, and these soon showed all the symptoms of the malady—one in a mild form, but the other so severe that it died.

But it must not be forgotten that in experiments undertaken with the object of proving whether a disease may be contagious, there may be no results at times, and yet this negative evidence cannot be accepted as a certain proof that there is no contagium. It is above all things necessary to take into consideration all the circumstances which might operate in rendering the transmission of the infecting element less certain. As we have already seen, these circumstances are not few; and among the most notable is the refractory condition of animals at times to the reception of a particular virus.* However virulent and active a contagium may be, or

* The fact that in some instances during the prevalence of a contagious malady, cases appear to spring up as it were spontaneously or independently of contagion, is but a negative proof of its being non-contagious. In every epizoötic and epidemic disease, such a phenomenon

however subtle in its operation, it will always be remarked that some individuals are proof against it, for a time at least; and there is no external indication which would betray this antagonism—nothing in the constitution to account for this indifference to the assault of such an enemy.

Some diseases, too, which belong to a miasmatic or malarious order—such as "influenza" in the horse—often extend widely, and it is very much open to debate whether some of them are not contagious, at least at times, it being often difficult in the extreme to furnish proofs in the affirmative. When, in the absence of any communication or contact, and when no animals have been imported from infected localities, a disease breaks out in every direction; and in the places where it originated, as well as in those in which it afterwards shows itself, it appears to have no regard for the law of contact, but indiscriminately affects the isolated and the animals moving freely about, sometimes sparing those in the very middle of the diseased localities, and no trace of a contagium at work can be discovered; then we are forced to admit that the disease is malarious or miasmatic, and independent of contagion.

A contagious malady may be said to have three periods, whose duration, though distinct and necessarily limited, yet offers nothing very precise. At first, the number of animals affected is few, though the malady may be most serious; then comes a period when a great number are involved, and the virulency of the disease is intense; then we

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will be noted; but this is no argument against the disease being propagated by contagion. In diseases notoriously contagious—such as the Small-pox of man, and the Cattle-plague of ruminants—numerous observations show this; and it is in view of such instances that Dr. Watson remarks—"If Small-pox be produced by contagion alone, and the mode in which the contagious matter has been communicated eludes sometimes our closest scrutiny, then we must conclude that the same thing may happen in *other* contagious diseases, of which the contagious properties may not be so strong or so obvious." And surely, says the same great medical authority, this ought "to warn us against the inferring of analogous disorders that they are necessarily not contagious, because we often fail to discover any way in which the poison could have been applied."

have the period of decline, when the number attacked decreases, and the symptoms become less severe.

Diseases which are due to contagion, besides being known by the family likeness they bear, extend in proportion to the multiplicity of the points of contact offered to them, their commencement being at times less violent, and always less extensive, than epizoöties due to other agencies. These latter are usually sudden in their appearance—sometimes affecting a whole locality or wide tract of country almost at once—then they become circumscribed or concentrated in one region, only to start up suddenly in another—all the while having much relation, in regard to their progress and intensity, with the season of the year, the sanitary condition of localities, food, and other predisposing causes.

In the contagious epizoöty, though these may have still some influence, yet it is far less than in diseases due to purely malarious or miasmatic agencies. The extension of a contagious disease demands four conditions, which are absolutely indispensable. These are : (1) the presence of a virus, (2) its integrity, (3) its contact with living tissues, and (4) its absorption. The absence of one of these conditions opposes an insurmountable obstacle to the propagation of a contagium ; and this knowledge is most important, as it enables us to contend successfully against the inroads of a " catching " disease. For being apprised that certain conditions are required for the full development of an animal poison of this kind, and that, in its most active form, as it advances it makes all creatures and every substance with which it comes in contact a new basis for its pernicious powers, we have at once a key to the problem of how it is to be met and destroyed, or at least kept within very limited bounds.

THE GEOGRAPHICAL EXTENSION OF EPIZOÖTIC AND CONTAGIOUS DISEASES.

THE geographical limits, or rather extent, of epizoötic and contagious diseases is a study full of interest and importance, and is closely related to the subject of sanitary police measures. We can only allude to it briefly in this place, leaving its further consideration until we come to describe each malady.

Certain maladies are more frequent in some countries than others, and some are never witnessed beyond certain regions; while others are primarily developed in particular localities, appearing to be influenced in their production by some unknown cause—perhaps of a climatic nature, and under favourable circumstances extend from these in various directions into regions to which they are foreign.

Very few transmissible diseases are maintained by a virus which is permament in its attributes. The contagious diseases which are supposed to arise spontaneously in countries where they find the conditions necessary for their evolution, when imported beyond their birth-place, depend solely for their existence on their virulent element; and when this becomes feeble or perishes, the maladies disappear. This may be because climate, geographical position, and other circumstances are unfavourable to its protracted or continued regeneration.

The terrible Cattle-plague has not a well-defined geographical limit. From the very earliest times it has been supposed to travel from Hungary and the east of Europe; and certainly its inroads have always been noted to commence in that direction, and to extend towards the west.* More recent in-

* In my work on "Animal Plagues," I have given an account of these inroads from the very earliest times up to the end of the last century. The first allusion to the home of this disease is contained in the very curious poem, "De Mortibus Boum," written by Sanctus Severus, in the fourth

vestigations, however, prove that it prevails beyond Hungary (in which it is not really indigenous), and is known in Southern Russia, Hindostan, Central Asia, China, Cochin China, Burmah, Assam, and Ceylon. It is unknown in Africa, America, Australia, and New Zealand.

It only appears in Western Europe as an imported disease, and we have no experience to guide us in forming an opinion as to whether it would become naturalized here; its terrible and sudden destructiveness, and the small per-centage of animals which escape, compelling governments to resort to most energetic measures for its extinction. In its native regions, however, like similar contagions, it disappears spontaneously, as it were; and at uncertain periods, obeying some unknown influence, it has epochs of recrudescence, when it inflicts great loss, though not at all to be compared to that experienced in our temperate climate.

But some contagions introduced into countries where they were before unknown, become naturalized, as it were, and fixed in their new home, in consequence, it would appear, of their greater vitality or tenacity.

The bovine contagious Pleuro-pneumonia belongs to this class. Two centuries ago, this very destructive and insidious disease had a very limited location in Central Europe. Gradually it began to show itself beyond its accustomed haunts, and owing to the absence of all sanitary control or organization to check its progress, for more than thirty years it has been playing havoc among the cattle of this country. It has localized itself wherever it has been imported, and within a few years has been carried into Asia Minor, South Africa, North America, Australia, and New Zealand.

Aphthous fever (Foot-and-mouth-disease) is, by the best

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century, in which Ægon a shepherd, lamenting his bad fortune in having lost all his cattle, says :

> " Hæc jam dira lues serpere dicitur
> Pridem Pannonios, Illyricos quoque,
> Et Belgas graviter stravit, et impio
> Cursu nos quoque nunc petit."

authorities, believed to have the same geographical origin as Cattle-plague, generally entering Europe from the east, and following the lines of traffic towards the west. Though known on the continent for a long period—about two hundred years—it was not imported into this country until 1839. Like other contagious maladies, its extension is coincident with increased traffic in cattle; though its brief incubatory period is less favourable to its existence than Pleuro-pneumonia. Like the Cattle-plague, it is indigenous to Asia and Ceylon—perhaps to Africa—and probably has the same geographical range. In 1872, it appeared in Melbourne, Australia, but was promptly suppressed: manifesting itself first in May, in an English bull which had been imported from England in the previous February.

Rabies is another contagious disease which has been extending itself within the historical period; nevertheless, certain countries are yet exempted—South and West Africa, Australia and New Zealand, St. Helena, and Madeira, for example. Spontaneous outbreaks have occurred in Peru, North America, and other countries; and it is probable that, in time, the terrible contagion will be universally diffused.

The Sheep-pox, though it may be suspected that it visited certain regions at a very early date, has evidently only naturalized itself in Western Europe since the sixteenth century. The geographical limits of the disease are not well ascertained, but in this country it is always an imported disease. It is probably of African origin. Cow-pox is known in nearly every region of the globe,* and Glanders is also a malady which is pretty generally diffused. It was not known in Mexico, according to Liguistin, until the Americans intro-

* Vaccinia is not at all unfrequent in South America, and Humboldt states that, for a very long period, it was known to confer immunity to mankind from an attack of Small-pox. Horniberger informs us that at Besherri, in the Lebanon, he tried to vaccinate the inhabitants, but was unsuccessful; and was told that more of them caught the Small-pox, because their cows have sometimes the Cow-pox, the origin of which is caused by the change of climate.—*Thirty-five Years in the East*, p. 13.

duced it, and does not appear to have shown itself in Australia, and rarely, if ever, in India.

"Strangles" is an equine malady which we have no evidence to show is prevalent beyond temperate climates, and the miasmatic disease, "influenza," which some authorities believe to be contagious in some of its visitations, is also a malady observed chiefly in temperate and cold climates.

The contagious Venereal disease of horses, first observed in Russia, spreads only by actual contact ; but within less than three-quarters of a century it has extended through the principal countries of Europe, and was introduced by the French into Algeria, where it is well known to affect animals kept for breeding purposes, over a wide extent of territory. There appears to be no limit to its diffusion, sexual intercourse alone being necessary to ensure its propagation everywhere.

Contagion appears to be the chief, if not the sole, agent in the spread of the general diseases which affect the domesticated animals ; the only doubtful exceptions, in some instances, being such maladies as Influenza and Anthrax (to a certain extent).

As commerce between nations becomes increased, and as the facilities for carrying animals from their native regions into other countries—no matter how distant these may be—are rendered more numerous, these diseases are certain to be carried with them, unless man's foresight and watchfulness be brought to bear more wisely and energetically than hitherto. Contrary somewhat to what is observed in human maladies, there appear to be very few animal contagions which are not endowed with sufficient vitality to withstand the action of any climate. The immunity of some countries from Rabies—Australia and South Africa, for instance—may be merely accidental ; for we know that, within a comparatively recent period, this frightful malady has appeared in lands where it was before a stranger.

Unfortunately, though England has had a splendid opportunity for investigating the geographical limits of particular animal diseases, and their varying characteristics in different climates, but little has been done in this direction, and our

knowledge is therefore of the crudest and most meagre kind. Nothing can be more interesting or important than the effects of temperature, climate, or topographical configuration of a country on the poisons of the contagious diseases, and even on parasitism. Just as certain non-parasitic diseases have their geographical distribution, so have those which are due to parasitism; and though some of these may be imported into a new region, yet the parasites may perish in the first generation. I have seen horses brought from India to North China (Pekin and Tientsin) affected with the *Dracunculus* (chiefly about the hock), and yet the malady was unknown in that region, and the parasites were not reproduced.

Other diseases, again, are more violent in some countries than others, especially when they attack new arrivals.

PART THE SECOND.

THE PREVENTION AND SUPPRESSION OF EPIZOÖTIC AND CONTAGIOUS DISEASES.

GENERAL OBSERVATIONS.

THE OBJECTS OF MEDICAL SCIENCE.

THE aim and end of medical science may be said to consist in (1) the *prevention of disease;* (2) its *suppression,* when it has appeared; and (3) its *cure,* which means the restoration to health of animals suffering from disease.

With the latter, medical sanitary science does not deal, it being allotted to that department of medicine which embraces therapeutics. It is, therefore, beyond the limits which the sanitarian has prescribed for himself, and will receive no further notice here. In the third part of the work, nevertheless, a brief section on the curative measures to be adopted for each disease will be given; as there are maladies for whose extinction sanitary and therapeutic measures may be most beneficially combined.

VALUE OF VETERINARY SANITARY SCIENCE.

The *prevention* or *prophylaxis* of disease must hold the first place in medical and sanitary science, and its importance cannot be over-estimated; for its object is to render the development of maladies impossible, and to preserve individuals or masses of animals from their invasion.

The *suppression* or *extinction* of a disease when it has become developed, occupies the next place, and is scarcely of less moment than prevention; while both require a perfect knowledge of its nature, the causes to which its development and maintenance are due, and the measures necessary for the removal or neutralization of these causes.

To *prevent* a disease is, to the man of science, to be able to recognize the conditions on which its origin and development depends, and to be competent to submit these conditions to such modifications as will nullify their tendency to produce the morbid condition, or hinder their operation. This necessitates a study of many subjects, and demands the exercise of the highest faculties of the human mind.

And the *suppression* of a spreading disease requires, in addition to this knowledge, an acquaintance with the laws upon which its extension depends, and the best means for counteracting their effects; so that the malady may be extinguished as speedily, and with as little loss and inconvenience, as possible.

But though possessed of all this knowledge, the sanitarian, from a variety of circumstances, but chiefly from the opposition or ignorance of individuals, may not be able to utilize it wholly, or even in part, for the public benefit; so that the advantages to be derived from his studies may be partially or altogether lost, unless he can obtain the concurrence and aid of those who are in a position to frame laws and enforce their observance, with a view to applying this knowledge efficiently, and of course beneficially. The assistance of the law-maker has, therefore, to be invoked; and to the political economist and legislator, who must, in the first instance, draw his inspirations from the sanitarian, preventive medicine, as applied to the domesticated animals, must appear a subject of the greatest moment. To be able to avert the ravages of an impending epizoöty, may be to preserve his country from a grave crisis; and to suppress a disease that destroys thousands of creatures—more particularly if the agricultural wealth of a country, consisting chiefly of useful animals, constitutes a large portion of the national capital—is not only to spare it

the direct loss such a malady causes, but often to relieve it from anxiety and hardship.

For it must be remembered that the majority of the maladies which come under the cognizance of veterinary sanitary science, more or less directly affect every branch of agriculture, and that the damage they cause is not limited to the immediate pecuniary loss and inconvenience attending the inefficiency or death of those affected, but extends to the breeding and multiplication of animals, embarrasses one or more departments of commerce, and generally injures, to a more or less considerable extent, the well-being of mankind. Not only are such diseases formidable by the damage they inflict, but some of them are most serious from the pernicious influence they may exercise on the public health, either by their transmission to mankind by contact or accidental inoculation, or by the use of the flesh or products of the diseased animals as food. Some of the most dreadful and fatal maladies are thus occasioned.

The maxim that "prevention is a thousand times better than cure," is founded on the experience—some of it of a very painful kind—of many years; indeed, its truthfulness appears to have been recognized from the very earliest times, though the lesson it inculcates has only too frequently been forgotten. Many of the spreading diseases of animals are not amenable to medical treatment; so that the expense and trouble incurred are completely thrown away. Meanwhile the contagia may be so virulent and subtle, that they are continually and widely spread through attempts to cure; and if the diseases are very fatal, the loss incurred may be enormous and distressing. We have but to remember what happened in Britain during the reign of the Cattle-plague, in 1865 and 1866. And even if easily remedied and not very fatal, but yet highly contagious, their treatment must be attended with expense and inconvenience; while their wide-spread existence, and the loss of service, condition, and productiveness of the animals (to say nothing of the suffering they experience) may render an easily-preventible disease a heavy calamity. We need but instance the so-called "foot-and-mouth" disease. This is,

therefore, neither a scientific, a rational, nor a profitable occupation; and Science is unworthy of the name if it neglects preventive measures, even in ordinary cases of disease, and bungles over a useless remedy, or consumes half the value of the creature it attempts to cure, when it might, at scarcely if at any cost, have maintained it in health.

Deeply impressed with these facts, the governments of almost every European country pretending to any degree of civilization, have for years been wisely and carefully studying the subject of these diseases, with a view to their prevention and suppression. By several of them, laws have been judiciously framed, a veterinary sanitary department or service under government auspices and control has been organized, and the carrying out of the preventive measures has been committed to its care; the whole scheme of organization being chiefly founded on the assistance to be derived from well-educated and thoroughly-trained veterinarians, on whom must always devolve the most important and responsible share of the duty in preventing or arresting the spread of destructive diseases. A word from this department, and the machinery of a vigilant government, careful in protecting its subjects from loss, is immediately put in movement; and in this way disastrous consequences are averted, almost without effort, and at a minimum cost. Not only is this organization invaluable in this direction, but it is found to be almost equally valuable in other ways—such as maintaining the necessary inspection of slaughter-houses; ensuring that the supply of animal food is of healthy and proper quality; keeping a watch on the movements of animals throughout the country with regard to their sanitary condition, and particularly with regard to the existence of contagious diseases; affording instruction in contagious diseases, hygiène, &c., to agriculturists and others; and the drawing up of reports on the health of animals, in which are contained suggestions for their improvement and better management.*

* In Belgium and Switzerland we have an organization of this description; in the German States it is the same; and even in Russia there is a very perfect veterinary sanitary service. In Germany, each administrative dis-

Not only this, but recognizing the all-important subject of veterinary education, schools have been established by these

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trict has its "Bezirsthierarzt," or veterinary surgeon, who is appointed after having been at least two years in the practice of his profession. His principal duty is at once to visit any part of the district within his charge, in which a contagious or suspicious malady has been reported; and after ascertaining the state of affairs, he immediately draws out a report in duplicate, a copy of which is transmitted to the veterinary medical council, which superintends these district veterinarians, and is in communication with the government; and in the meantime he prescribes to the local authorities the provisional sanitary measures which he thinks necessary. In Belgium and some other countries, in addition to this and other duties, the district or county veterinary surgeon gives "conferences" on farriery and hygiène in different places once, or more frequently, in the year.

In Russia, there is a veterinary committee, which has the same attributes as the German medical council, and has complete control over everything relating to the *personnel* and organization of the sanitary service relating to animals. The ukase establishing this service is dated December 22, 1868, and thus refers to the organization :—

"The committee is charged : (1) to elucidate the measures necessary for the improvement of the veterinary service, and the arrangements necessary to prevent epizootic diseases ; (2) to publish popular information with regard to the hygiène and management of the domestic animals; (3) to draw up summaries of reports and instructions for the use of veterinary surgeons ; (4) to inquire into the value of new discoveries in veterinary medicines ; (5) to analyze and, in certain cases, to authorize the sale of pharmaceutical remedies intended for the domesticated animals ; (6) to consider the desirability or the feasibility of measures intended to facilitate the transport of cattle ; (7) to determine, on the roads traversed by cattle, the places where a veterinary surgeon is necessary ; (8) to examine the propositions made with regard to the construction of lazarets intended for animals which have sickened in travelling, and to ascertain the expense these proposals may necessitate ; (9) to give counsel with regard to the assurance of cattle ; (10) to give attention to any other questions within the domain of scientific veterinary medicine.

"Veterinary surgeons will be required to attend professionally to the droves of the cattle-dealers ; they should, therefore, be fixed along the principal roads.

"The veterinary surgeons above mentioned will have for their special duty the sanitary inspection of these herds, and will (1) treat those animals left with them by the cattle-dealers ; (2) declare immediately to the local police the occurrence of any contagious disease in a travelling drove, and assist the local authorities in their efforts to prevent its spread.

governments, who have exercised every care in the selection of teachers and in the general management, in order to ensure a thorough course of study, and the supply of competent graduates.

ESSENTIALS OF A VETERINARY SANITARY SERVICE.

In the most enlightened countries, then, the first essential in the prevention and suppression of destructive animal diseases, and, though secondary, the improvement of animals, has been the "establishment of schools" wherein veterinary science should be thoroughly taught, in order that the public might reap the advantages of having well-instructed and reliable veterinary surgeons. The trouble and expense thus incurred has been well rewarded; and as evidence of this we might point to France, Belgium, and Germany.

The next essential is the "organization of a veterinary sanitary service," under a minister of agriculture, or other responsible individual in the government. This department should be founded mainly on central administration, and be entirely independent of local interests, prejudices, and influences; it ought to be endowed with full powers to carry out the measures which may be deemed necessary, and which are in conformity with legislative enactments passed with a view to the prevention or extinction of these diseases.

"By the aid of the funds derived from the tax on these droves, with the sanction of the local authorities and the cattle-dealers, special sheds along the high roads will be erected; these will be for the sick animals."

In Holland, a similar veterinary sanitary service has been organized, and the different districts have their government veterinary surgeons, or "Veeartsenijkundige ambtenaars:" all under a principal veterinary surgeon, who is responsible to the government, controls the actions of these functionaries, and presents an analysis of their reports. In Zealand, the veterinary sanitary service, for instance, is constituted by twelve veterinary surgeons—one first class, four second class, and seven third class. These are nominated by the States-deputies, and must be legally qualified practitioners. Their district and place of residence are designated by the States.

The third essential is a "code of laws and regulations" founded on a knowledge of these diseases, and carefully drawn up, so as to be readily applied, and framed to meet every exceptional case.

1. *Veterinary Schools.*

The establishment of veterinary schools in Europe was, in the first instance, due to the terrible destruction wrought by spreading diseases among animals—and especially the Cattle-plague—towards the middle of the last century. To France belongs the honour of having instituted, under the illustrious Bourgelat, the schools which have more or less served as models to other countries, and have done more to advance veterinary science than any other institutions of the kind. From the benefits they have, during so many years, conferred upon France, the wisdom evinced in founding them has been abundantly manifested. But not only have these government schools been beneficial in the highest degree to that country; to other nations they have served as examples, and some of the men who have made veterinary science famous in these countries were trained at the French establishments.

In every European country, except England, the veterinary schools are under government management and control, and are, in fact, national institutions; for it has been recognized that veterinary science and education being of the greatest importance to the public welfare, they cannot be left to the chances, abuses, and misadventures of private enterprise, but should be guarded with the greatest care, and rendered as perfect as possible. For this reason it is that the teachers are men of excellent education, specially selected, and generally after having undergone a public competition, devised to ascertain their thorough fitness for the task they are to undertake. They have a certain fixed salary, which is increased according to merit and ability, and has no relation to the number of students at the schools, nor the rapidity with which these can be turned out and replaced by others; while their promotion depends entirely upon their zeal and scientific attainments. Hence it is that many of these

teachers take high medical degrees at the universities, and their names are familiar to those who study the annals of medical science. We have but to mention those of Chauveau, Bouley, Colin, Renault, Reynal, Ercolani, Gerlach, Hering, Gurlt, Hertwig, and Röll, as evidence of this.

And the teaching of the students is conducted with the greatest care and deliberation. Before being allowed to enter one of the recognized schools, each candidate must prove that he has received a good education, such as will enable him to understand what he is taught, and ensure his maintaining the reputation of his profession when he has graduated. His studies are conducted in a systematic manner, and there is no attempt at "cramming;" as the earliest period at which he can present himself for examination is after four years' study, nearly the whole of which has been spent at college.* But even this period is now being generally considered as too brief, having regard to the multiplicity of the subjects that must be taught, their increase almost every year, and the greater necessity there exists for veterinary surgeons possessing the highest qualifications.†

With respect to veterinary schools and veterinary education,

* In Britain, the period of college instruction is scarcely twelve months, and the preliminary examination is of the most elementary character.

† The history of veterinary science in Britain is a most unpleasant and unwelcome theme, and does little credit to us as a civilized and civilizing people. We have the best horses, cattle, and sheep in the world; they form a large portion of our national wealth, and have cost great study, care, and expense to perfect; our empire is the largest on the globe, and its prosperity mainly depends upon the care with which these animals are protected from disease, and improved. Yet in the matter of veterinary education, we are as far behind every European State—even the very poorest—as we are in advance of them with regard to agriculture and our knowledge of animal breeding. It is difficult to account for this; but it may arise from the fact that the advantages to be derived from veterinary science have never been understood nor appreciated in England.

It is curious to find that, while chairs are endowed at our universities for teaching the most abstruse and unprofitable subjects (speaking comparatively), veterinary science and the science of comparative pathology, which are capable of conferring the greatest possible advantages, in a humanitarian, scientific, and utilitarian point of view, should be so strangely neglected.

then, a country which is desirous of preserving itself from animal plagues, of perfecting its agriculture, and enhancing the value of the domesticated animals, must give these its first attention; as in direct proportion to the care with which veterinary science is fostered, and its graduates instructed, will these objects be attained.

2. *Organization of a Veterinary Sanitary Service.*

Having pointed out that the best veterinary schools are those which are under government management and control —in fact, "national schools;" that the system under which professors are appointed, because of their high scientific attainments and zeal in forwarding the interests of veterinary medicine, is the best; and that a sound veterinary training acquired by men who had previously received a good general education, was a prime essential towards sparing a country the embarrassment, danger, and loss due to the presence of animal diseases, we have now to notice the next essential —the organization of a veterinary sanitary service. Such an organization is absolutely indispensable, and the more complete it is, so the more perfectly will it respond to the demands made upon it.* Just as a company of soldiers, a regiment,

* Hurtrel d'Arboval proposed a veterinary sanitary service for France many years ago, upon the following basis :—In each department of North France, veterinary surgeons, appointed by the préfet, were to be specially charged with the duty of watching the progress of any disease from the place where it appeared, towards other places; they were to study its various ways of propagation, to inform the authorities with regard to every fact concerning its contagiousness, to visit the fairs and cattle-markets, and indicate those local sanitary measures which experience had proved to be useful; they were to assist councils on hygiène, and to be at the disposal of the préfet and sous-préfets, ready to proceed to any place in the department when these magistrates wished to be informed quickly and correctly as to the progress of disease. These veterinary surgeons were to collect and analyze all the documents relating to diseases, so as to afford the fullest information with reference to hygiène, sanitary police, and statistics. They had, besides, the inspection of the lazarets, when it was deemed necessary by the administration to establish these, in order to temper the rigours attending the prohibition of cattle by admitting them after a certain period of quarantine.

an army, is drilled and disciplined, and organized to perform certain duties, so should a service of this description. The chief instruments in carrying out the duties of such an organization must be veterinary surgeons, and upon the integrity, zeal, and scientific knowledge displayed by them will in great part depend its success.

As has been stated, a proper and efficient veterinary sanitary service must be mainly founded on central administration, and be largely, if not altogether, independent of local influence and opposition. It should be constituted by, and be under the direction of, a responsible minister, and ought to consist of a central commission, council, or committee, county veterinary inspectors, and district inspectors. The functions of the commission should be to collect and analyze all reports relating to epizoötic and contagious diseases, with a view to determine the measures necessary for their prevention or suppression. This commission should correspond directly with the county veterinary inspectors, who must forward to it, in duplicate, copies of the reports they have addressed to the chief authorities of the county, these reports being based upon those the district inspectors have furnished. The commission should, in addition, prescribe the duties to be performed by the county and district inspectors, trace out forms of reports to be drawn up on special subjects, and issue a yearly or half-yearly report for the information of the public, with regard to the existence and spread of contagious and epizoötic diseases, the measures adopted for their suppression and the result, and the general duties performed by the department.

Each county veterinary inspector should be appointed by the central commission, and ought to possess special qualifications for the duties he undertakes. He ought to reside in the county town, and be at the disposal of the chief authority in the county entrusted with such functions as those pertaining to the prevention or extinction of animal plagues, &c. He must direct and control the district veterinary inspectors, receive and summarize their reports, forwarding these to the central commission, and be held responsible for the prompt execution of the orders issued by the latter. If the county is

extensive or thickly populated, or it is otherwise necessary, the county inspector may have an assistant-inspector.

Each county should be divided into sanitary districts; the number of these depending upon the size of the county, the number of animals therein, the density of the population, and other considerations. Each of these districts should be well defined, and placed under the supervision of a district inspector appointed by the central commission. The duties of this inspector ought to be distinctly set forth, and his services should be utilized to the utmost. The movements of cattle, sheep, horses, and other animals should be watched by him, if there is reason to apprehend the invasion of contagious diseases, or if these exist in his district; and the traffic in cattle and sheep, particularly during the prevalence of contagious diseases, ought to receive particular attention. At all times, the general sanitary condition of the animals within his district should be attentively observed. On the outbreak of a contagious disease, he ought immediately to report the circumstance to the local authorities, who will without delay inform the county authorities; measures being taken in the meantime to prevent the spread of the contagion, or to suppress it, according to the regulations laid down by the central commission. On the district inspector should devolve the duty of extinguishing the outbreak, and suggesting all necessary precautions, as well as the drawing up of the reports thereon. But we will allude hereafter to the special functions of this officer in the presence of a contagious malady.

His services should be utilized in inspecting slaughter-houses, animals about to be slaughtered, the flesh of animals sold as food, as well as knackers' establishments, and reporting on subjects connected with sanitation. He should be competent to deliver addresses to the owners of animals with regard to the management of these, with a view to the prevention or suppression of disease, and the improvement of the domesticated animals. The subject of enzoötic diseases should particularly receive his attention.

If possible, the district and county veterinary inspectors should not be allowed to practise their profession privately,

but devote the whole of their time to these public and most important duties. Private practice is incompatible with inspection.

With such an organization, contagious diseases would become rare indeed; and when they did appear, their extinction would be easy and prompt. The benefits otherwise conferred would be immense, and would be greatly to the advantage of the public. No other organization can be efficient; and its adoption would prove far less costly, vexatious, and harassing than severe regulations imperfectly carried out during the existence of these maladies.*

* In Britain, there was no veterinary sanitary service to suppress contagious diseases among animals previous to the invasion of the Cattle-plague in 1865. Though the country had been severely and continuously scourged by most destructive, and we might almost say ruinous, maladies of a preventible kind for more than twenty years, no attempt whatever appears to have been made to establish any kind of organization to check them. The appalling losses inflicted in a very brief period by the Cattle-plague showed the disadvantages of such carelessness; and then we had the Veterinary Department of the Privy Council.

Though everything appears to have been conducted with a view to economy, yet, looking at the very little it has effected, and the cost, it must be confessed that no more expensive organization could well be devised. In fact, the organization is utterly incompetent to deal with the existing contagious diseases, Lung-plague and Foot-and-mouth disease—both extending solely through their contagious properties—being, perhaps, more fatal and destructive now than before the creation of the department. It has failed for a number of reasons, but chiefly from the fact that, in order to avoid expense, there has been employed unfit men—policemen and others, utterly unacquainted with animal maladies—to detect most subtle contagious diseases. A small number of veterinary surgeons are sometimes called in, at second hand, to verify these men's statements; but these experts do not watch the extension of disease, nor report as to the traffic that goes on in diseased and contaminated cattle. Such a duty is beyond their province; and even if called upon to perform it, it is questionable if it would not greatly damage their private practice. In fact, the two duties are incompatible, and can never be efficiently performed. It requires an expert entirely independent of local pecuniary influences, to prevent or suppress the extension of contagious diseases. For this reason it is that the traffic in diseased and tainted animals goes on, it may be almost said unhindered; and the regulations in force, while useless so far as the extinction of the diseases are concerned, are harassing, vexatious, and costly in the extreme.

3. *Legislative Measures.*

THE necessity for legislative measures to prevent and suppress contagious diseases among the domesticated animals, need not be alluded to here. It is sufficient to say that, from the highest antiquity, law-makers and law-givers have recognized how important it was to "keep the clean from the unclean;" and throughout history we find more or less reference to sanitary legislation, which only too frequently was imperfect in the extreme, because based on miserably crude notions as to the nature and causes of disease. With the perfecting of medical knowledge arose that important department of medicine—sanitary science—which is now recognized as absolutely essential to the welfare of every community. But the benefits this science is capable of conferring cannot be made available without the aid of the legislator; as ignorance, indifference, self-interest, and other influences are constantly in operation with regard to the production, introduction, maintenance, and extension of contagious maladies; and it is only by bringing the powers of the law to aid in applying the knowledge of the man of science that these scourges can be checked. Sanitation and legislation are, therefore, closely allied in what may be termed "sanitary policy;" indeed, they are mutually dependent upon each other in the matter of contagious diseases, and the sanitary policy of a country may be properly designated its "medical legislation." To the medical man belongs the scientific section of sanitary policy; to the legal authorities its administrative division.

There is no uniformity in carrying out the regulations in different counties, or even in different districts; so that while they may press severely and vexatiously in one place, they may be almost ignored in another. There is no centralization, and even if there were, it would be of little avail without proper instruments in the shape of competent Government experts. A tithe of the loss sustained in one county from the effects of Foot-and-mouth disease, would maintain a sanitary service well adapted to deal with these scourges, greatly assist the development of agriculture and comparative pathology, and prove of immense public benefit in other respects.

The first furnishes the scientific data relating to sanitation; the latter devise suitable laws and regulations based on these data, and provide the means for applying them, so as to secure the greatest possible benefit to the community at the least inconvenience and cost. The practical value of the legislative measures, and the efficient manner in which they are carried out, mainly depend upon the intelligence and ability of the legislator and administrator in availing themselves, to the utmost, of the advice tendered by the man of science, who, of course, must be fully competent to advise in everything relating to contagious diseases and other matters connected with sanitation. For it must be remembered that veterinary sanitary science ought not, as is generally imagined, to limit itself to a consideration of contagious diseases, as they affect animals only; but, going beyond this, should study the injurious effects that these maladies exercise on mankind, and on the public health; the serious consequences that contact with infected creatures, their carcasses, or the manipulation of their *débris* may entail; the influence that flesh, milk, and other animal products may have in the production of disease in the human species; as well as the utilization of such products as skins, wool, hair, &c., which often represent an important item of the public fortune; together with the inspection of flesh and milk, abbatoirs, butchers' stalls and shops, knackers' establishments, cow-sheds, stables, cattle-ships, markets, fairs, &c.

All these matters, which are of great national importance, come within the domain of Veterinary Sanitary Science, and more or less require the aid of the legislator in framing laws to enable them to be thoroughly carried into effect for the public benefit.

The legislative measures should not be numerous nor complicated; indeed, there should only be one law, or Act, with administrative regulations based thereon, and forming a special legislation. These regulations should be comprehensive, and yet simple, clear, and easily interpreted. The more they partake of this character, the more likely are they to be efficiently carried into practice; and the less frequently will they be transgressed by those who should observe them, and who are not

always very enlightened, or capable of understanding the full purport of legal enactments as they are usually drawn up.

There should be regulations with regard to each malady; as there is a wide difference between contagious diseases, with regard to their gravity and destructiveness, and some require more severe measures than others. The nomenclature of these diseases should be carefully attended to; so as exactly to define them, and to determine precisely the circumstances and cases in which the law is to be applied.

The regulations should be capable of alteration and amendment, with the progress of scientific knowledge, commercial relations between countries, &c., and to be prepared to act promptly in such an emergency as the invasion of a new infectious disease, or one which is not included in the regulations, a special clause might be introduced applying to "any other reputed contagious malady."

These regulations should be as seldom as possible permissive; on their being imperative depends, in a great measure, their utility, as local authorities rarely act in harmony when they are allowed much latitude in carrying out regulations of any kind; and local influences are frequently so powerful, or the competition in cattle traffic, jealousy, &c., between districts or counties may be so great, that the carrying out of the regulations in their integrity may be entirely subordinated to these. The licence allowed these authorities in carrying out the measures necessary for the prevention or suppression of contagious diseases should, therefore, be sufficiently restricted, so as to ensure uniformity of action over a whole country, if need be.

The measures should be as little vexatious and harassing as possible, to individuals or particular interests, having a due regard to circumstances, and more particularly the intention of the law. To obviate discontent, and to a certain extent infringement of the regulations, those whose interests are more particularly involved should be enlightened as to the necessity for the application of the law, by being instructed with regard to the malady or maladies to be prevented or suppressed—their nature, symptoms, modes of extension, &c.,

with the hygiènic and preventive measures specially applicable to each, before, during, and after the appearance of the diseases in a district or country.

The great object is to secure intelligent co-operation in carrying the law into effect, and this can only be done by acquainting every one with the duty devolving upon him, and the necessity for complying with the regulations. Individual initiative is, after all, the principal ally to be enlisted in preventing or suppressing contagious diseases ; and the more effectually this is stimulated, the greater will be the success attending sanitary legislative measures. Once make the public, and more especially those immediately concerned, understand that sanitary legislation is not meant to be oppressive and harassing, but is founded on the highest motives, and based on the most reliable existing knowledge ; that the measures are intended to preserve the domesticated animals from disease, and protect the public health and interests ; and that needless sacrifices will be studiously avoided—do all this, and unless there is grave mismanagement, and the measures are either badly devised or enforced,, contagious maladies should be either altogether unknown, or easily and promptly suppressed.

Not only this, but it would render offences against the sanitary laws much less frequent, many of these being committed through sheer ignorance; and it would allow the authorities to visit with severe punishment those found guilty of wilful violation.*

* There can scarcely be a doubt that the prevalence of contagious maladies in this country has been largely due, in addition to the causes already mentioned, to the neglect of these matters. The ignorance prevailing with regard to the nature, early symptoms, and contagious properties of the maladies which have been for years scourging the country, as well as the measures necessary for preventing their extension, is something astounding. No attempt appears to have been made to disseminate information in this respect, and only too frequently the orders and regulations have been looked upon as oppressive and uncalled-for. Not only this, but unfortunate farmers, drovers, and cattle-salesmen, it is to be feared, have been, in many instances, punished for infractions of the law, without knowing that they were doing wrong.

The penalties attaching to violation of the sanitary laws should be proportioned to the nature of the infringement. The concealment of a contagious malady, the knowingly permitting contaminated animals to mix with those that are healthy, or clandestinely trafficking or disposing of animals so affected, should be far more severely punished than an offence which has been committed through ignorance, though carelessness ought not to be exempted from a heavy penalty.*

GENERAL MEASURES.

THE general measures prescribed by veterinary sanitary science for the preservation of the health of animals, and their protection from epizoötic and contagious diseases, comprise those of a *prophylactic*, *preventive*, and *suppressive* kind.

PROPHYLACTIC MEASURES.

The "prophylactic" (from προφυλάσσειν, to defend from disease), or "preservative" measures of veterinary sanitary science are of great importance; indeed, they must hold the very first place in all attempts to deal with disease; but it must be frankly confessed that it is most difficult, as a rule, to establish them on a scientific basis. As has been before mentioned, to prevent the development of a disease is to know the circumstances which favour or oppose that development; in a word, to understand its etiology. When speaking of the nature of epizoötic affections, it was mentioned that the diseases of a multitude, or, as we may term them, a collection of organisms, are like those of an individual in that collection—the consequence of two agencies; one operating internally or "predisposing," the other exercising its influence externally, or "exciting." From this point of view, prophylactic or preservative measures have a twofold object: (1) To fortify

* The Contagious Diseases (Animals) Act, now in force in Britain, is inserted in the appendix.

or alter the constitution of the collective organisms in such a manner as to render them proof against the influence of the external cause, by removing the predisposition ; and (2) to prevent the external cause from coming into operation by any means which science may be in a position to suggest.

Unfortunately, in only too many instances we know but little, if anything, of the primary causes which induce widespread maladies; nothing, we might say, of that "atmospherical taint," that *nescio quid*, whose existence we cannot deny, because its effects are so striking and characteristic.

Being, therefore, in ignorance, so to speak, of the nature of these causes, or the way in which they act, we know not how or when to protect animals exposed to their influence. And even in special cases, when the cause is well known—as in maladies the result of famine, or due to disease in the vegetable kingdom, or when the cause has otherwise a universal and visible character—prophylactic measures are not always successful in checking the progress of the epizoöties so engendered.

Importance of Hygiène in Sanitary Science.

As the diseases of the domesticated animals are numerous; several of them beyond the reach of curative measures; and others not always easy, and certainly never profitable, to cure; it is most essential that the laws of hygiène be fully understood and obeyed, and that the closest attention be paid to the removal of what may be considered predisposing causes of disease, even when no disease is prevalent.

A rational and well-founded system of hygiène, by fortifying the body, and preserving the different organs in health, is the most certain safeguard against the development of disease. A suitable and sufficient diet, an abundance of air and light, a regular amount of exercise, no undue exposure to weather, as well as cleanliness, and suitable locality, form the basis of a good hygiène, and indeed in outbreaks of some diseases are all we can rely upon for the preservation of healthy animals. In "influenza," for instance—a proteiform malady which cannot yet be classed among the certainly contagious diseases—we are left no other recourse than hygiènic measures.

Nevertheless, even in such a malady as Influenza, it is always desirable to add to these measures that of isolation of the healthy from the sick. With all diseases this is a prudent step, and more especially with those spreading maladies, the infectious nature of which cannot be absolutely denied.

With regard to enzoötic diseases, such as "rot," "anthrax," &c., animals may certainly be preserved from them by the adoption of hygiènic measures, and by the removal or modification of the conditions upon which the origin and maintenance of these maladies depend. But this is sometimes most difficult, if not altogether impossible, to carry into practice. Prejudice may offer insurmountable obstacles ; perhaps quite a revolution in the pastoral, agricultural, and economical habits, as well as the hereditary customs of a nation, sect, race, or tribe, has to be effected before a dangerous and deadly malady can be eradicated. And if we attempt to modify the natural features of a region to which, we may be satisfied, are owing the development of a particular disease, the time, labour, and capital required for the undertaking may far more than outweigh the loss caused by the malady. And after all, perhaps constant efforts may be required to ensure the suppression of the morbigenous cause.

Such attempts often require, not only the counsels of science, but the sanction, influence, and active aid of governments. History abundantly testifies to the fact that some enzoötic diseases due to locality, feeding, work, &c., become limited in their scope, or entirely disappear, as agriculture and hygiène are better understood. For instance, some of the more malignant forms of Anthrax—as Anthrax fever, splenic Apoplexy, Glossanthrax, Hæmaturia, &c.—which at one time played such terrible havoc in this country, are now comparatively rare, or altogether unknown in districts then most severely visited. On the contrary, in countries where civilization is not much advanced, and agriculture is in a very primitive condition—as in Russia—these affections are fearfully frequent, and as destructive as they were in Britain some centuries ago.

When it has been fully ascertained that a disease is trans-

missible, and due to a material cause, then, of course, prophylactic measures are simple.

MEDICAL AND CURATIVE MEASURES.

Not much reliance can be placed upon medical preservative treatment during the prevalence of epizoötic and contagious diseases, notwithstanding the many attempts to discover remedies and the boasting of charlatans, who can readily produce a specific prophylactic for every malady of this kind, and who are ever on the alert to prey upon the public when misfortunes, in the shape of wide-spread disorders, appear. Their specific is nearly always as injurious as it is absurd.

When animals are debilitated, tonic and stimulating agents are useful in enabling them to resist the attack of some diseases, or to withstand their effects when they are invaded.

When therapeutic measures are adopted in this respect, it can only be with the intention of hindering the ulterior development of a disease, the germ of which already exists; destroying a contagious principle which has found its way into the body; or assisting in the removal of a normal or abnormal predisposition to certain maladies.

We have as yet but few data on which to found any reasonable hope that medicines will prevent the attack of specific disease. Nevertheless, those we are in possession of give us reason to expect that valuable results will ultimately be obtained in this direction. At present, we may refer to the facts obtained with regard to the influence of sodium sulphite in protecting, to a marked degree, from septicæmia and typhoid conditions after inoculation with putrid pus, &c. Also those resulting from the use of carbolic acid in Cattle-plague, Foot-and-mouth disease, and contagious Pleuro-pneumonia. In the former disease, when animals were made to respire an atmosphere charged with carbolic acid vapour, and at the same time received small quantities of that compound in their food, it was found that they did not become affected while so treated.

And Anthrax has been successfully combated by small doses of carbolic acid at frequent intervals. Dr. A. Smith, speaking

of the benefits to be derived from the use of these "internal disinfectants," says that, "It is better to kill an animal with a good disinfectant than let it die putrid, and ready to kill others." But, as Finlay Dun remarks, "The risk of killing, even by the direct injection of disinfectants into the blood, is small." Mr. Crookes injected into the veins of Cattle-plague patients one ounce of sodium sulphite, and in other experiments seventy-eight grains of carbolic acid, or nearly sufficient to preserve the whole mass of the circulating fluids from putrefaction; and though not usually saving the patients, these injections always diminished the febrile symptoms for a time, and reduced the increased temperature. Adopted more frequently, as Mr. Dun suggests, their curative results would probably have been much greater.

Curative measures are generally not successful in the majority of the spreading diseases—hence the great importance of preservative and preventive measures. We have with each disease, in the following part, indicated the principles of medical treatment to be adopted.

PREVENTIVE MEASURES.

If science is often at a loss to indicate in what way those epizoötic diseases may be averted which depend on some unknown agencies, perhaps emanating from the earth, tainting the waters, or contaminating the atmosphere, it is not so when these maladies rely solely for their maintenance and extension on the presence of a contagious element. It is here that the preventive measures of enlightened governments, when founded on a sound scientific basis, and carried out by an efficient veterinary sanitary service, are most valuable and certain; and when we reflect on the number and the grave character of these contagious maladies, which become epizoötic simply from their being allowed to exist, we see at once what a power is given us to check or subdue what might soon become, if neglected, a great national misfortune. Witness the Cattle-plague in this country in 1865 and 1866.

It is by these measures that exotic maladies, developed, we know not how, in a region or country, may, when contagious,

be restricted to their native soil; and in all invasions of virulent diseases, it is to these preventive measures, combined with those of a suppressive kind, that we must trust for their extirpation. Medical treatment of such diseases is not only always unprofitable, and only too frequently unsuccessful, as has been already said, but when the contagium is exceedingly virulent and subtle—like that of Cattle-plague and Sheep-pox—and the mortality is very great, then it is most reprehensible, nay, barbarous to the last degree; because it exposes healthy and helpless animals to the attack of a painful and destructive disorder. Such a course is neither scientific nor humane.

Vicq d'Azyr, who lived in an age when curative measures were esteemed far before those of prevention, has well said: "The physician may certainly, by means of a suitable *régime*, and some fortifiants prudently administered, bring the individuals exposed to the deadly influences of a contagious disease into a state of robust health, and this may retard or diminish the attack of the dreaded enemy; but it is assuredly beyond his power to close all the loopholes by which it may enter, or to avert by a potion the danger of contact. These pretensions, which are the offspring of unmeasured vanity or the grossest ignorance, are an imposition, and inspire a dangerous confidence, which, sooner or later, claims its victims. We have often seen vain or superstitious men, who, during the epidemics which attack the human species or the lower animals, hold out promises they were not competent to redeem."

In the presence of a highly contagious and fatal disease among the domesticated animals, curative measures of an experimental kind should not be entertained except in the regions in which it is indigenous, or in special hospitals where every care can be exercised to prevent the dissemination of the virus. And even with a contagious malady which is not very destructive, and may be readily amenable to medical treatment, prevention will, in every instance, be found more profitable and satisfactory than the trouble and expense of

administering drugs and the depreciation in the value of the animals, or the loss of service occasioned by the disease.

The first and most important indication of sanitary science, is the prevention of contagious diseases, and the next is their suppression when they have appeared. These indications should, as we have already urgently insisted upon, be the subject of legislative measures; which, again, must be carried out by skilled agents, whose efforts should be seconded by the hearty co-operation of those for whose benefit a veterinary sanitary service is maintained.

1. *Traffic in Animals.*

The traffic in animals* between different countries is yearly assuming such immense proportions, through the facilities offered by railways and steamships, and the vastly increased demand for animal food, that one of the first objects of a veterinary sanitary service is to examine how far this traffic influences the extension of contagious diseases. For it is evident that, with importations from certain regions where particular virulent maladies prevail, unless the greatest possible care is taken previous to sending animals from these regions, or before admitting them to the country for which they are intended, there is every probability of the diseases being also introduced. And such has been the case times out of number: commerce, and at times the events of war, have widely disseminated the most fatal scourges among animals, and particularly the bovine and ovine species, upon which human populations mainly rely for food.

* Here and elsewhere in this section I have employed the terms "animals" and "cattle" as comprehensive designations for one or more of the domesticated species. The general measures indicated may not all be applicable to the contagious diseases of all these animals, but are chiefly intended for cattle and sheep; nevertheless, some of them are as necessary in the prevention or suppression of the spreading maladies of the horse, pig, or dog; and even these may convey the infection of the bovine or ovine species. The special measures required for each malady will be described in the part which treats of these.

2. *International Sanitary Regulations.*

With a view to render sanitary measures effective, in this respect, the regulations with regard to the prevention of contagious diseases should be international, and as nearly uniform as may be possible. The existence of contagious disorders among the flocks and herds of an importing region must, in addition to the damage they inflict at home, be productive of still greater injury if infected or suspected animals are permitted to enter other countries and contaminate healthy creatures; for the importing country will be looked upon with suspicion, and its trade in cattle and sheep greatly damaged. The extinction of contagious diseases is, therefore, of international importance, and this result cannot be achieved, nor their diffusion entirely prevented, until certain international sanitary measures are adopted. Every country, for instance, should to a certain extent be held responsible for the introduction of preventible contagious diseases into another country by means of infected animals; this would lead to steps being taken that none but those free from infection should be exported. An inspection of the animals should be made by thoroughly trustworthy veterinary officials, whose certificate—specifying the number and species of the animals, date of inspection, their freedom from actual disease, and the absence of suspicion with regard to contamination—should accompany them. The veterinary authority at the port of embarkation should also certify that the vessel has been thoroughly cleansed, and, if deemed necessary, disinfected; also that it has appliances for watering and feeding the animals. Again, a country in which a contagious disease has suddenly appeared should be bound to report the occurrence to other countries which receive its exported animals, in order that these may be placed on their guard against the admission of the contagion.

3. *Interdicted or Scheduled Countries.*

Until these international measures are introduced, the countries into which animals are exported will run great risk of infection among their own herds and flocks with diseases carried

by the new arrivals. This risk may be so great, and its consequences so serious, that it may be absolutely necessary to prohibit importations of one or more species of animals, either temporarily or permanently, according to circumstances. This is a severe measure, but it is rendered imperative in such diseases as Cattle-plague, Sheep-pox, and even in Foot-and-mouth disease. It has the advantage of compelling the authorities in the infected country to get rid of the malady as speedily as possible, and to take every precaution with regard to its re-appearance. Countries permitting the importation of cattle from those which are infected should also be regarded as interdicted.

4. *Inspection and Quarantine.*

The risk of having contagious diseases introduced into a country by importations, is partially obviated by a system of inspection at the ports or frontier stations by which these cattle are admitted; and it is nearly altogether abolished when a sufficient quarantine can be carefully carried out. The inspection should be carefully and not hurriedly performed. In the case of cattle, sheep, and pigs, fit for immediate slaughter, this inspection need not be so strict if they are to be killed at the point of entrance and dressed for food; though the skins and offal, should the animals have come from an infected or suspected country, ought to be thoroughly disinfected as a precautionary measure. With animals intended for fattening, or with fat stock which is not slaughtered on arrival at a port or frontier station, the case is different, and more especially if they come from an infected region. A period of quarantine equal to the maximum duration of the latent stage of the apprehended disease (including the time occupied on the journey, provided no case occurred in transit) should be enforced, if there is any reason to apprehend infection; this measure being carried out at these places in properly contrived enclosures. Special markets might certainly be devised for these importations, without imposing the hardship of quarantine; but there is always the danger of the native animals becoming infected through the foreign ones travelling to these

markets ; and, besides, the purchasers at these may become instrumental in introducing disease by carrying the new stock into their own districts, should it happen to be infected. Such stock would require the closest supervision until it could be pronounced absolutely safe.

Cattle from scheduled countries should, if possible, only be those fit for immediate slaughter—fat stock—and they should be killed and dressed at the port of debarkation, in slaughter-houses set apart for the purpose. Those, however, which come from countries free from contagious diseases may be lean or store stock, and should be landed and kept entirely apart from the others ; and no communication should, if possible, be permitted between the two places without due precaution being observed.*

Cargoes or droves of animals arriving at a port or station affected with a contagious disease, or should the malady appear while they are in quarantine, must be slaughtered at once, and every precaution adopted, according to the rules laid down for such cases. The veterinary authorities should decide as to the expediency of utilizing the flesh and other products of these animals, and each port or station should be provided with every convenience for such a contingency.

5. *Inland Traffic.*

With regard to inland traffic, when contagious diseases exist in a country, the same precautions are necessary to prevent the spread of infection.

6. *Railway Waggons and Cattle Ships.*

The railway and cattle-boat traffic should be particularly attended to, and care must be taken that not only is there

* In this country, foreign cattle are inspected at the arrival port, after an interval of at least *twelve* hours from the time they were landed. Those from scheduled countries are landed and slaughtered at a certain part of the port defined by the Privy Council ; while those from unscheduled countries are landed, put into sheds, and inspected in another locality of the port, and if no disease is present they are then sent inland.

provision made for carrying the animals in a humane manner, but that danger of their receiving infection from the waggons or ships is avoided by thorough cleansing and disinfection after discharging each cargo, and before receiving another. As, in modern times, animals for the butcher and the market are frequently, if not generally, carried by railway, and as this mode of transport renders the transmission of contagious diseases over wide surfaces in a brief space not only possible, but very easy of accomplishment, it is absolutely necessary that the railway waggons employed to carry animals should be completely deprived of all risk of contamination by being kept clean and disinfected, even when no contagious malady prevails. This should also be done with vessels that carry animals, as well as places—such as stations, buildings, sheds, &c., where they halt for any length of time.

This disinfection, as we shall see hereafter, ought to be carefully performed, and should consist of a thorough cleansing, with brushes and water, of every part that has been soiled by the animals; the manure and remains of food being carefully collected and destroyed or buried, and all necessary precautions adopted. The waggons, platforms, and other places and objects with which the animals have been in contact, as well as the brushes, shovels, &c., should be scrupulously cleansed by means of boiling water or very hot steam.

If contagious diseases prevail, or if sick or suspected animals have been carried by them, ships and waggons should be, in addition, disinfected by the most efficient means. It would be well if, during these periods, the carriage of animals destined for slaughter were conducted in special ships or waggons, which ought not to be used for the conveyance of store or breeding stock. After disembarking each load, waggons and ships, as has been mentioned, should be disinfected, dried, and well exposed to the air.

Halting places for cattle on the lines of railway, should be well away from the ordinary cattle-roads, and completely isolated, to prevent contact with home-bred animals.

At large traffic outlets, as at seaports, no diseased or sus-

pected animals should be permitted to leave, and their condition on arrival should be closely observed.* The same

* In Great Britain and Ireland such measures as the above appear to be scarcely in existence, and are almost ignored; nothing at all like efficient inspection being carried out in the latter country, it has been for years, according to all reports, an inexhaustible generator and nursery of contagious diseases. Cattle, sick and healthy, have been regularly shipped without let or hindrance to England and Scotland in the most wretched cattle-boats, exposed to the greatest hardships, conveyed in railway trucks without food or water, lodged in lairs and pens, driven into markets and fairs, and thence to healthy farms in every direction; thus sowing the seeds of the most destructive and ruinous diseases, without any attempt being made to check them at their source. At the same time, the regulations in force in England, which, however imperfect they may be, have never been fully carried out from the absence of any proper sanitary organization, were vexatious and rendered null by this continual importation of infection. It is a matter of common observation, that Irish cattle nearly always introduce contagious diseases into localities in England and Scotland, and there can scarcely be a doubt that they are much more dangerous at present than foreign stock, so far as contagious Pleuro-pneumonia and Foot-and-mouth disease are concerned. A competent observer in 1873 makes the following remarks in explanation of this sad and unwarrantable state of affairs:

"The prevalence of Foot-and-mouth disease in Ireland is shown by the fact, that last year 220,570 cattle were reported to the constabulary as affected with the disease.

"The disease was either more prevalent, or more generally reported, in the districts round the three following ports of shipment—Dublin, Drogheda, and Waterford.

"Irish farmers not unfrequently neglect to report the outbreak of Foot-and-mouth disease on their farms.

"The punishment for this offence, and that of driving affected cattle along a public road, is often limited by the Irish magistrates to the imposition of a nominal fine, such as one shilling; and the law has even been made to appear ridiculous by the 'infliction' of a fine of one penny.

"Stock exposed for sale in markets or at fairs in Ireland, are not inspected as they are in England, except at Dublin, and perhaps at some other places not visited.

"At Ballinasloe fair, this year, one inspector was employed by the Government to examine over 70,000 sheep in the course of two days, and more than 12,000 cattle on another day. Foot-and-mouth disease was found by the inspector in the course of the fair; but the magistrates declined to carry out the provisions of the Privy Council (Ireland) Order of November, 1870.

regulations should be applied to them, in fact, as to foreign animals.

"The provisions of the Transit of Animals (Ireland) Order of May, 1871, with regard to the cleansing and disinfecting of railway vehicles and pens, are openly disregarded. The Government does not enforce the provisions of the order.

"Nearly all the yards or lairs belonging to the steamboat companies at the ports of shipment in Ireland, are as dirty as the railway cattle-trucks and pens; so, also, are many of the market-places.

"There is no inspection of cattle at the Irish ports of shipment.

"The steamboats are not in all cases cleansed and disinfected with sufficient care. They are always rendered sufficiently clean to take a return cargo, but the disinfection is, in some cases, apparently paid less attention to.

"The ventilation of the holds of the vessels is generally bad.

"There is no inspection of Irish cattle when landed in England, as it is not rendered compulsory by the Contagious Diseases (Animals) Act, and local authorities at ports of landing will not avail themselves of the powers conferred upon them by the Act, in such a manner as to impose restrictions on animals coming to their own market.

"The Contagious Diseases (Animals) Act does not give any inspector the power of entry into private premises in the event of his suspecting Foot-and-mouth disease; and he, consequently, has no power of inspection of animals, except when they are exposed for sale, &c., in a public place (in England), or when in or on a public conveyance.

"After being landed and watered, Irish cattle are driven either direct to the market or fair, to the railway station, to a lair or cattle-shed, or else to a field or farm in the occupation of the salesman to whom they have been consigned.

"On the market, the cattle are inspected by the veterinary inspector appointed by the local authority; but his certificate of affection with Foot-and-mouth disease is not, under the Act, conclusive evidence of its existence.

"If the cattle are sent on by rail immediately after landing, to an inland farm, they are not inspected at all.

"If sent to a lair, cattle-shed, or field belonging to the consignee, previous to being sent to a fair or market, the dealer keeps back from the fair or market any animals that appear diseased, for fear of being fined for exposing in a fair or market an animal affected with an infectious or contagious disease.

"Such lairs, sheds, or fields, not being reported or disinfected, and in the absence of any power of entry, thus become nests of disease, the existence of which is not often reported; and in consequence of the number of

7. *Fairs and Markets.*

To prevent the propagation of contagious diseases in different directions by contaminated animals, special measures relative to markets and fairs should be promulgated and strictly enforced, if there is reason to expect such animals at these places. Fairs and markets are generally prolific sources of contagion. No animals should, therefore, be allowed to enter a market or fair unless accompanied by a certificate from the local authorities in a prescribed form, specifying everything relating to them—their number, species, sex, colour, marks, and particular characteristics; that in the district or county whence they come there was no contagious disease; and that the animals were in good health when they left.

The places used for the temporary reception of travelling animals, whether at ports or inland, besides being furnished with the necessary conveniences for the purpose, should be registered and certificated by the district or other authorities, be cleansed and disinfected according to the sanitary regulations, and they, as well as the animals they may contain, be in-

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cattle sent to these places from time to time, they are probably the most prolific source of contagion.

"Certain markets, such as Liverpool, are entirely for the sale of fat stock; no store stock being, as a matter of fact, sent there. In such cases, the inspection can only be of use where slaughter-houses for killing diseased beasts are provided close to the market. No slaughter-house is licensed for the purpose adjacent to the Liverpool market, and infected beasts must, therefore, be driven from the market to private slaughter-houses by roads which may convey the infection to the next lot of store or dairy stock driven along them.

"The confliction of interests between urban and rural localities not unfrequently causes the regulations in force, or more often the manner in which they are carried out, in the town or port, to differ from those in the adjoining district. Interested persons take advantage of this want of agreement, and thus diseased animals pass into the country."

After this description, we can have no reason to wonder that contagious diseases are so widely prevalent in the three kingdoms. Ireland, until free from contagious diseases, should be put on the same footing as suspected foreign countries, with regard to export cattle; while a veterinary sanitary service on the same model as that recommended for England, should be instituted for the prevention and suppression of these maladies.

spected by the district veterinary inspector as often as may be deemed necessary.

If before arriving at the place where the market is to be held, one or more of the animals have been disposed of, the authorities of the locality in which the sale was effected should notify the same in the certificate.

Animals which are not accompanied by a certificate of this kind, should be considered as suspected, and ought not to be admitted into the fair or market until carefully inspected by a veterinary surgeon.

During the continuance of the market or fair, a veterinary surgeon should be always present in an official capacity. His duties should be a general surveillance of the sanitary condition of the animals, reporting immediately to the authorities any suspicious circumstances that may occur, and carrying out any measures which may be deemed necessary for the prevention of disease.

Slaughter-houses should be provided as near the market or fair as possible, in order to dispose of any infected or suspected animals, or for other useful purposes.

All sales of animals should be registered by the clerk or other responsible agent attending the fair or market; so that, if necessary, the diffusion of a contagious disease, should it chance to appear, may be readily traced by the local and other authorities.

8. *Butchers' Establishments.*

As butchers generally make their purchases in different localities, their establishments should more particularly be made the subject of close inspection by the district veterinary surgeon. The animals they intend for slaughter should not be allowed to remain in the same stable with other animals; neither should they be permitted to graze on pastures or commons with those of the locality; as if one of the former should happen to be diseased, the contagion might soon assume formidable proportions.

For the same reason, the local authorities should be careful on insisting that the cattle for slaughter, as well as the flesh of

those slaughtered, should be submitted to a scrupulous inspection; for it may happen that by this inspection the existence of a malady, previously more or less suspected, will be made out, as it only too frequently happens that the owners of animals hasten to sell to the butchers those which are affected with disease, but which they are desirous of concealing. The local administration should therefore be on the alert in seeing that this inspection is carried out in a thorough manner; while the county authorities ought to assure themselves, from time to time, that the inspector's reports are drawn up properly, and they should interfere promptly when any irregularities are detected.

Butchers who kill animals and sell their flesh without this necessary inspection, should be liable to severe penalties. By this inspection, the existence of disease in unsuspected stables and localities may frequently be traced; for there cannot be the shadow of a doubt that an extensive clandestine trade is carried on in animals affected with contagious maladies, and to this traffic the maintenance and diffusion of these is greatly due.

9. *Medical Treatment of Diseased Animals.*

No proprietor or guardian of animals should be permitted to treat those which are diseased, as they may thus readily infect any healthy creatures they may chance to go among, if the malady is contagious.

Knackers should also be prohibited from treating diseased animals, or keeping them alive on their premises for any length of time; and these men should not be allowed to go among healthy animals, or into the places where these are kept.

10. *Newly Purchased Animals.*

No newly purchased animals should be admitted among home stock without the authority of some competent and legally appointed inspector; or, failing this, they should be subjected to a certain period of quarantine in a place apart

from the home animals, until the time over which the incubation of the apprehended disease extends has expired.

11. *Travelling Cattle.*

Travelling cattle should not be lodged in the same stables, nor placed in the same pastures, with others; but be kept apart from them, and have special attendants, and also, if required, special utensils.

The localities which are frequently traversed by travelling animals can, of course, be preserved from the danger of contact with these, by the authorities forbidding all passage through these localities, or limiting them to certain specified roads situated at some distance from habitations and pastures. Where this cannot be carried out, the inhabitants of the localities should confine their animals in sheds or well-enclosed places during the passage of the strange droves or flocks, and if the apprehended malady be of a very virulent character, and the virus carried by the fæces, the home stock should not be permitted on these roads until all the excrement is carefully removed. The latter should be collected in a heap, put into a cart drawn by a horse (if the disease is not transmissible to the equine species), and carried to a place inacessible to animals which are capable of receiving infection; there it ought to be buried. The persons who have been employed in this service must not be allowed to go near the susceptible animals in the locality until they have been thoroughly freed from infection.

If a number of strange animals must pass the night in the vicinity of a particular locality, a place should be set apart for them; and this place ought not to be immediately afterwards occupied by the native animals. All communication between these and the strangers should be interdicted, as well as intercourse between those who have charge of the latter and the people of the locality, if the apprehensions of disease are well founded; and every care should be taken that none of the new arrivals unaccountably disappear, or are clandestinely sold because of disease. Those animals which, through sickness or suspicious fatigue, cannot follow the others, must

be sequestrated, watched, and cared for until a certain period, corresponding to the incubation of the apprehended disease. If the latter develops itself, then they should be killed, and, if necessary, a careful necroscopical examination made with all due precautions. Then the carcasses should be disposed of according to the regulations laid down for contagious diseases, the remainder of the animals treated as infected or suspected, and none of the food which has been in direct or indirect contact with them given to other animals, but carefully destroyed.

12. *Removal of Cattle.*

When a farmer or other person removes from one locality to another, he should not be permitted to remove his animals until the local authorities are satisfied as to their health; if necessary, this should be attested by a written certificate from the district veterinary surgeon, to be given to the authorities of the locality to which it is desired to move them. An infraction of this regulation should be punishable by fine, and the farmer should be held responsible for any damage that may result from the infraction.

13. *Cattle Dealers and Drovers.*

Cattle-dealers should be licensed and registered by the authorities of the district in which they usually reside, and unlicensed dealers ought not be allowed to traffic. The license may cost a small sum, and be liable to be suspended or withdrawn by the authorities when the regulations are infringed by these persons. Drovers, or persons regularly entrusted with the care of animals in transit, should also be licensed by these district authorities, and their license held on the same terms as those of the dealers.

14. *Knackers.*

Knackers should likewise be licensed, and their establishments open for inspection by the district veterinary surgeon, as well as the local authorities.*

* Many of these places in this country are perfect abominations. Fixed in the midst of overcrowded localities, filthy and noxious in the extreme, and under no proper surveillance, they are a source of pollution to mankind and cruelty to animals. Not unfrequently there is a regular traffic in diseased animals carried on in them.

SUPPRESSIVE MEASURES.

When a contagious disease manifests itself in a locality or district, and more especially if it is of a serious character, then prompt measures are necessary to limit, and ultimately suppress it; such measures are consequently of the greatest moment, as delay or carelessness in their application may entail grave results.

These measures are related to the: (1) Declaration by the owners of animals, or other persons, of the existence, or suspected existence, of the disease; (2) Visit; (3) Isolation of different kinds; (4) Enumeration; (5) Valuation; (6) Marking; (7) Veterinary surgeons and guardians of animals; (8) Interdiction of fairs and markets; (9) Prohibition of buying and selling; (10) Suppression of grazing; (11) Notice to neighbouring localities; (12) Occision or slaughter; (13) Choice of a slaughter and burial-place; (14) Utilisation of the carcasses of diseased animals; (15) Compensation; (16) Employment of Policemen; (17) Disinfection and disinfectants.

The exactness or severity with which any or all of these measures must be enforced, will be in direct proportion to the potency or subtlety of the contagium, the mortality accompanying the disease, the loss it may occasion by depreciating the value or utility of the domesticated animals, or the danger to which human beings may be exposed. For this purpose, a distinction must be made between the various contagious maladies, many of them differing in their effects, modes of transmission, &c., and some being much more dangerous than others by reason of their subtlety, power of infection, mortality, and other attributes.

Without attempting in this place to enter into great detail, or to do more than furnish a general outline of the applicability and utility of the various measures, we will now proceed to their consideration.

1. *Declaration.*

To facilitate the verification of an enzoötic or epizoötic contagious disease, and, consequently, to allow of its being

quickly extinguished, every owner of animals should be compelled to report immediately, to the proper authorities, any suspicious case of disease occurring. This declaration should be obligatory, even if there is no epizoöty in the locality; and this obligation ought also to be extended to shepherds, cow-herds, drovers, and others in charge of animals beyond the immediate supervision of the proprietors.* Veterinary surgeons ought also to be bound to report to the authorities, animals which they have been called in to treat when these present actual or suspicious symptoms of a contagious malady, or even if they chance to know of such animals; and they should impress upon owners the necessity for making such a declaration without delay.

Inspectors of fairs, markets and slaughter-houses, butchers, knackers, and all others placed in a position to observe animals, should also be expected or compelled to report any suspicious circumstance connected with contagious diseases.

This declaration is the most important measure of those necessary for the suppression of these maladies; indeed, it may be said that the others depend upon it; and on the promptitude and readiness with which it is made mainly rests the success of the sanitary arrangements adopted.

Owners of diseased or suspected animals should, therefore, in their own interest, so far as preserving the rest of their stock is concerned, or receiving compensation (which we shall allude to presently) for those which it may be necessary to destroy, lose no time in conforming to this most essential measure. They should also remember that reporting the outbreak of a

* In continental countries, great stress is laid upon this declaration, and in some of them severe penalties are inflicted when it is neglected. In France, for instance, by article 459 of the Penal Code, it is stated that "holders or keepers of animals affected with, or suspected of, contagious diseases, who shall not have given notice at once to the *Maire* of the Commune in which they are, shall be punished with imprisonment for from six days to two months, and a fine of from sixteen to two hundred francs." In Germany, Bavaria, Austria, Belgium, and Switzerland, a similar law exists.

In some of these a reward is often offered to any one who declares the existence of a contagious malady.

contagious disease, and more especially if it is very virulent, is a duty they owe to their neighbours, and even to their country; while its concealment is unfair and unpatriotic, and for the damage thereby caused they are responsible. Such a declaration is a warning of danger to every one, and enables the authorities to suppress, at its very commencement, what might soon prove a terrible infliction. It is a thousand times better to raise a false alarm about what may be only a benignant disease, than to delay reporting what may prove to be a formidable contagion.

It has frequently been said that the owner should not be greatly blamed or punished if he does not declare the existence of a contagious disease, as perhaps he may not be able to recognize it, and that to distinguish it requires special knowledge. But this excuse has scarcely any foundation in fact; the immense majority of proprietors of animals understand sufficiently the ordinary symptoms and characteristics of the most common disorders of this class—which in this country are, after all, the most serious, with the exception of Cattle-plague—and some will even pretend that they know them better than veterinary surgeons; it must therefore follow that they have no pretext of this kind to shield them; and in the case of a new disease, they must necessarily be struck by its unusual character, as well as by its affecting a number of animals in more or less rapid succession. For a report should certainly be made when several cases of a disease follow each other at close intervals, either in the same place, or in others adjoining. Besides, it is to the interest of the owner to call in a veterinary surgeon, who would then enlighten him as to the nature of the malady.

It may be true, nevertheless, that the proprietor who conceals the existence of disease does not reflect on the dangers and losses to which he exposes others; and is less guided by an intention to do harm, than to cure his animals, perhaps, by following the advice of some empiric and so save them, instead of exposing himself to inconvenience by making known that they were infected.

The non-declaration of a contagious disease should be

punishable in all cases; but its concealment ought to be looked upon as a much more grave offence, than the neglect of reporting it from any uncertainty as to its nature. Persons who knowingly traffic in animals affected with such diseases, should be severely punished; as their whole aim is concealment and the profit to be gained by the misfortunes of others.

The success of this measure essentially depends upon the existence of another—that of full compensation for losses sustained thereby. Without compensation, few proprietors, indeed, will report the existence of a contagious disease among their animals; the sacrifice made for the benefit of the community might entail ruin upon them.

The declaration should be made to the police, or any other regularly constituted authorities, and may be verbal; though, if the occasion will permit, it would be better in writing, as it would then afford stronger evidence, in case of dispute, that the law had been obeyed.

On receiving the report, the authority will take the necessary measures, which are described below; and if the outbreak is serious, the intelligence may require to be made public as quickly as possible, the symptoms and necessary precautions being also published if the malady is not very well known. Until the deputed veterinary surgeon has arrived—indeed, whenever the owner has reason to suspect the existence of a disease—the animals should be isolated from those which are healthy, and their movement among others, or sale, should be rigorously prohibited.

2. *Visit.*

The declaration being received, it is the duty of the authority to send the veterinary inspector as quickly as possible to visit the animals, and investigate the nature of the malady, as well as prescribe any urgent sanitary measures to ensure safety, should it prove to be contagious. This visit may be ordered by the authority who receives the declaration at first hand; and, according to circumstances, the superior authorities are immediately informed, or the report of the veterinary inspector re-

ceived before this step is taken. The object of the visit is mainly to discover the exact state of affairs, and in doing this the veterinary inspector should commence with an examination of the healthy animals, then the suspected, and, lastly, the sick, in order to avoid becoming an agent in the propagation of the disease. We shall refer more particularly to his functions hereafter.

3. *Isolation.*

Isolation, when thoroughly carried out, is, after the declaration, the sanitary measure *par excellence*, for suppressing all contagious diseases. Its object is to preserve healthy animals from infection, and its advantages were known and made available, even by legal enactments, in the earliest times; when it is combined with the declaration measure, and both are rigorously carried out, they will, in almost every instance, arrest the spread of a contagious disease. The healthy must have no means of communicating with the diseased or suspected, and the degree of isolation must depend upon whether the malady is propagated by a fixed or a volatile virus. Judgment and care must be exercised in interposing every obstacle to the transmission of the contagium in either one or the other condition; mediate and immediate contact must be scrupulously avoided, while the distance to be maintained between the healthy and diseased must depend upon circumstances, but should always be as great as possible, according to the nature of the infecting agent.

The separation should be effected in such a manner that the healthy shall be located in a non-infected place, and the sick in the infected quarter.

The healthy should be attended by persons who have no communication whatever with the diseased or suspected, and those who look after the latter must not be permitted to go near the former.

The manner of carrying out this measure is based on the knowledge possessed with regard to the different contagious diseases, and the various ways which the infecting principle may be conveyed. These are:—

The presence of diseased animals in the same locality with healthy ones; the contact of animals in stables, pastures, fairs, markets, &c., and on roads.

The communication between them of people or animals of the same or other species; mediate contact, by means of harness, grooming articles, clothing, forage, manure, stable utensils, &c.

Relations with the remains of dead animals.

The measure, if it be maintained in a perfect manner during the existence of the malady, must, within a certain time, deprive the contagium of its sources of propagation, direct or indirect; for the virus of all contagious diseases, like other animal matters, bears within itself the elements of self-destruction—it dies when it cannot be regenerated.

There are several kinds of isolation, which will now be noticed.

(*a*) *Sequestration.*—This is but another name for the most rigid and complete isolation, and may be termed a severe, but, in some cases, a most necessary measure. It consists in confining diseased or suspected animals in a certain place, apart altogether from those which are healthy, and preventing all external communication until the disease has been completely suppressed, and all danger has passed away. Horses, flocks, or herds are restricted to certain buildings or pastures, beyond which it is presumed the virus of the disease cannot possibly be conveyed. By this measure, not only may one or two animals, stables or pastures be so isolated, but whole villages and districts in which a very virulent malady prevails, may be cut off from all dangerous communication with the regions beyond.

There are sometimes many obstacles to be overcome in attaining effective sequestration, and not the least of these are the maintenance of the animals so sequestrated—if they be in large flocks or herds, and the space on which to graze them is limited—the providing them with water, and sheltering them from vicissitudes of weather.

This measure will, of course, vary according to the mode of transmission of the disease; but the great object to be aimed

at is completeness in its application, however it may be varied.

(*b*) *Cantonment.*—When a flock or herd is isolated on a piece of grazing-land, and assigned a space in which it may move about, this is called "cantonment." It is a measure intended to diminish the onerousness and inconvenience of sequestration, permitting, as it does, movement of the animals in the part allotted for the purpose of isolation. It is usually divided into *permanent* and *mixed cantonment.*

Permanent Cantonment is generally that chosen for the summer season, or fine weather, and is continued night and day in the pastures.

Mixed Cantonment is that which is prescribed when the weather is not so favourable ; and it is necessary that animals be put into sheds or stables, when it would injure them to be permanently exposed at such seasons. They are, therefore, left on the pasture or driven into sheds, according to the state of the weather, but are otherwise subjected to the same regulations as if in permanent cantonment.

In a thickly populated district, cantonment is not easily carried out : consisting, as it does, in placing the diseased flocks or herds on a plot of ground at a safe distance from any high-road, by-road, or village where healthy creatures liable to be infected are kept, pasturage on which animals feed, or are likely to feed for a certain time after—or, in a word, in any situation where they may be at liberty, and yet run no risk of spreading their disease by mediate or immediate contact. It is very difficult in a level country, or in one closely cultivated or divided into small farms ; and it is particularly so when the virus is very subtle and volatile, as in Foot-and-mouth disease, Sheep-pox, and Cattle-plague. When it can be undertaken with safety, it is a measure to be commended, because it permits the animals to enjoy the open air ; and if there is an abundance of good pasture, and the situation is otherwise favourable, recoveries may be more rapid than when they are confined to sheds, while the expense to the proprietor is much diminished.

As a rule, a piece of fallow or uncultivated ground is

selected (this selection should be made by the authorities), as far removed from all communication as possible, and bounded by a river, an unfordable stream, a wood, mountains, or any other natural limit, to prevent straying, and to define the boundary of the cantonment. If the locality is hilly, then it should be fixed between these hills. Should no natural obstacles to communication exist, then artificial ones must be established, and care must be taken to have them sufficiently defined and effective. If a river or stream be near to which the animals have access, it is necessary that precautions be taken to ascertain whether, in certain diseases, the water may not carry the infecting principle to healthy animals beyond the cantonment. If no running water is within the cantonment, then wells or pools must be made, or water conveyed to troughs by suitable means.

All the roads or paths by which communication might be effected should be rigorously interdicted, except those absolutely necessary for the passage of cantoned animals. The care of these should be entrusted to intelligent men, appointed, if necessary, by authority ; and their duty ought to be to prevent all contact or intercourse with people or animals from the surrounding districts, to which they themselves should not pass. No persons, except those officially delegated, should be permitted to come near their post, and all dogs or other animals capable of conveying the contagion should be driven away. They should keep their own dogs within the cantonment, and see the carcasses of the dead animals properly buried. Advantage should be taken of the natural features of the country, if possible, so as to screen the animals from winds which might carry the virus beyond the cantonment to other animals.

The situation of the cantonment should be publicly made known in the surrounding districts, and any breach of the regulations rendered punishable.

The duration of this measure will of necessity depend upon the nature of the disease, and should only be decided by the authorities.

(*c*) *Lazarets.* — In treating of preventive measures, the

establishment of a period of quarantine for animals arriving from scheduled countries was mentioned. This quarantine for suspected flocks or herds may be carried out in a special locality which might contain buildings for the purpose, and be situated at defined parts of a frontier, or at certain ports determined by authority. In this lazaret the animals are detained until the veterinary inspector can vouch that they are free from infection, when they may be allowed to enter the country. In this respect, quarantine is preferable to absolute interdiction, as it interferes less with trade and the supply of necessary food ; and provided the lazaret is properly situated and conducted, it is a safe procedure in dealing with infected countries. Quarantine, however, often leads to fraud, unless the lazarets are well managed and supervised.

Lazarets, however, may be usefully resorted to in other circumstances. When, for instance, a contagious disease of a particular character has gained a considerable diffusion in a locality, it may be necessary to establish them, in order to diminish the chances of transmission to the lowest degree. For this purpose sheds, stables, or other buildings may be made available, provided they are well away from frequented places ; or a single building may be constructed which will contain all the animals presenting evident symptoms of the disease. These should be attended to by persons who must have no communication with other parts of the locality ; and if deemed advisable, in these "disease lazarets" medical treatment may be resorted to for the cure of the sick, under restrictions which will be specified hereafter.

Those animals which have been found in contact with the diseased, and which, though apparently healthy, are yet suspected of being contaminated, should likewise be lodged in special lazarets apart from the others, and which might be designated "casual lazarets." If the weather is suitable, these suspected animals may be parked in the open air in groups of from five to ten. They should also be attended to by particular persons, and when any of the number exhibit unmistakable indications of the malady, they should be at once transferred to the "disease lazaret."

The dwellings from which the diseased and suspected have been removed should, of course, be cleansed and disinfected according to rule, and every precaution adopted before other animals are admitted.

The establishment of such lazarets can only aid in arresting the propagation, and consequently diminishing the duration, of a contagious disease.

When the malady is due to some other influence, of course isolation and these special buildings cannot prevent the action of that influence. And even when contagion is present, it is not always possible to procure lazarets. In such a case, the healthy should be removed as far as possible from the sick, so that at least direct contact may be prevented; and by the adoption of good ventilation, and paying great attention to hygiène, as well as resorting to disinfection, the virus may be robbed of much of its potency.

Lazarets, or "Sanitaria," for the assembling and medical treatment of sick animals during the reign of a contagious disease, have often been proposed both in this and the last century, and generally more with a view to try the effects of various remedies and plans of cure than with any assurance of benefit. But the scientific, and perhaps humane, motives which led to their proposal or adoption were not always well considered, when the malady chanced to be of a highly infectious and deadly character. In the last century, Bourgelat (the illustrious founder of the French Veterinary Schools), after ample experience, came to the conclusion that they are only likely, nay, certain, in the majority of instances in which they are tried, to be a means of spreading the infection, whether they are established throughout the whole extent of the territory in which the disease prevails, or whether only one is instituted for each village or district. In the first place the infected animals which are conveyed from their stables to a common centre may communicate the contagion to those which are healthy on each side of the way to these places; and in the second place, in multiplying the lazarets we multiply the expenses, and worse still, we multiply the

centres of infection. For each hospital is a focus where the virus is generated in quantity according to the number of animals collected therein, and where it acquires greater power of diffusion as it becomes more concentrated; and in spite of the wisest and most rigidly carried out precautions, this poison element which saturates the air, so to speak, cannot be limited to the lazaret, but will extend far beyond it. In these buildings, it is also notorious that the larger the number of animals congregated, so the more serious does the type of disease become, and the less successful the attempts at a cure. In some instances they may be advantageous; as when the disease is neither very contagious nor fatal, when they can be instituted on the farm where it prevails, and all proper precautions can be adopted to prevent the escape of the poison germs. In other instances they are not to be countenanced.*

(*d.*) *Interdiction of Localities.* The interdiction of a locality in which a very contagious disease prevails, is only an application of isolation to a larger surface. In such a malady as the Cattle-plague, for instance, it may be most essential that the locality in which it has appeared be isolated completely from others yet uninfected, until it has been entirely subdued. Admission into such localities should only be permitted on the most urgent plea, and without special permission the inhabitants ought not to be allowed to enter neighbouring towns or villages; while there should be as little movement among them as need be. Herds of cattle, sheep, or other animals, should be absolutely interdicted from passing through such localities; and, to preserve the adjacent country, placards in large letters announcing the existence of the contagion ought to be posted up at the roads leading to them. Men in whom confidence can be

* During the prevalence of the Cattle-plague in this country, in 1865-66, the establishment of sanitaria was much insisted upon by people who knew little, if anything, of the disease, and had the vaguest notion of sanitary science as applicable to the maladies of the lower animals. From the experience then gained of this scourge, and the inutility of such buildings, it is not probable that they will be tolerated in future invasions.

placed should be stationed around them to carry out these measures, and to see that neither flesh, skins, horns, or other matters likely to convey the infection are allowed to pass beyond the prescribed sanitary limits. The period when the interdiction may be removed must rest with the authorities.

This measure, applicable to a frontier as well as a locality, is most useful at the commencement of a contagious disease, and is then least onerous, as the restrictions can be sooner removed. Recourse to it can only be justified in such a dangerous disease as Cattle-plague.*

(*e.*) *Emigration.* The emigration of animals from an infected to an uninfected district or country is a measure which has been sometimes adopted, either to preserve them from the contagion, or to facilitate the recovery of those which are diseased. It is much in favour in some countries where the pasturage is very extensive, and with nomadic tribes which have large herds it has been a practice from time immemorial; but in cultivated regions, and where numerous small flocks and herds are kept, its application is exceedingly limited, and may even be impossible. Indeed, the measure is only really advantageous when the disease is due to a local cause—such as insalubrity of the pasture, malaria, and such other influences as produce enzoötic maladies, or when animals are in proximity to localities where contagious diseases prevail. When a contagious malady has assumed an epizoötic extension, owing to the uncertainty of all the animals in a flock or herd being yet uninfected, and the duration of the period of incubation being not always exactly defined, it becomes a very questionable measure; to say nothing of the impropriety of moving animals at all from one place to another at such times. Where an owner of animals has plenty of space, of course emigration is easily

* In Germany, and also at times in France, the assistance of the military is generally invoked to aid in carrying out this measure, which is a severe one, and only justifiable by the great interests at stake. In these countries it certainly is not required for any great length of time, as the diseased and suspected are at once destroyed, every precaution is adopted by the Government veterinary inspector, and the contagion is extinguished in a very brief period.

carried out, and then simply becomes cantonment of healthy instead of sick animals.*

4. *Enumeration.*

When a contagious disease of a serious character breaks out in a stable, farm, or district, and especially if there is much movement of animals therein, it is often a most useful step to obtain exact information with regard to the number of animals and their particular and individual marks, either of one or of several species, according to the nature of the disease; this return should include the healthy as well as the diseased, and also the names of the owners. It serves as a check upon the illegal removal of, or traffic in, animals in the infected locality—a proceeding which might extend the con-

* During the prevalence of the Cattle-plague in France, in 1766, an Ordinance was issued for the enforcement of this measure, in order to preserve a portion of the cattle of the kingdom, which appeared to be destined to lose its entire bovine population. All that were yet apparently healthy were collected from the interior of the infected regions, where the malady had committed fearful havoc, and carefully cleansed. Before commencing their journey they were marked on the right shoulder with a hot iron, indicating the initial letter of their county, and also numbered in the same manner. They were then valued by experts, and paid for in the presence of the magistrates, who drew up a report of the proceedings. When all was ready, an itinerary was drawn up for the guidance of those who were to conduct the animals to their new country. If the herds were very large they travelled by sections, and not all at once; each proprietor was compelled to furnish each beast with about ten pounds of hay daily when on the march. On their arrival at the appointed place, they were distributed to the owners, who came forward to receive them, and who were to pay the fixed value for them if, in about a year, they had escaped the mortality. A return was then made out of the designations of the parishes from which they had been taken, the number and value of each animal, the name of the district or village to which it was now to be conducted, and that of the man who had it in keeping.

These measures, though dictated by prudence and expected to be attended with success, were not, however, productive of all that was desired. Indeed, Vicq d'Azyr, who speaks from experience of this preservative scheme, tells us that if now and again it succeeded on a small scale, when attempted largely it had a thousand inconveniences of the gravest kind.

tagion far and wide. We will see hereafter how and when this measure should take place.

5. *Valuation.*

When the disease is of such a character that it is found to be most judicious to destroy the sick and suspected, in order the more promptly and surely to extinguish the contagion at a minimum cost, it is an essential step to value each animal susceptible of the disease at the same time that the enumeration is made.

6. *Marking.*

Marking diseased and suspected cattle, so that, should they be moved beyond their defined limits, or attempts be made to smuggle them away, they may be recognized and seized, is a judicious measure when there is reason to apprehend that the law generally will not be respected.

There are various modes of marking animals, such as clipping the hair in a particular manner in a certain region; using red-lead or other staining matter not easily effaced; imprinting a particular number or figure on the hoof or skin by means of a hot iron, &c.

7. *Veterinary Surgeons and Guardians of Animals.*

The persons to whom is confided the care of sick or suspected animals should be more or less scrupulously watched, according to the contagiousness of the disease. These persons should have nothing to do with healthy animals, nor yet be allowed to go near them, nor with persons or things likely to convey the contagion to healthy creatures. If they should chance to be removed from this office, they ought before leaving to be well cleansed, and their clothes and hands disinfected, as well as their boots; if disinfection cannot be carried out, then the clothes and boots should be changed.

The veterinary surgeons who have been attending to animals suffering from contagious diseases, should either only give their attention to these alone; or if they must also go

among the healthy, they ought to visit these before the sick, and special clothing (made of a material least likely to retain the virus), boots, &c., should be worn when among the latter. The free use of carbolic acid to disinfect the hands, clothes, and other articles, must also be resorted to.

8. *Interdiction of Fairs and Markets.*

The interdiction of fairs and markets in infected localities can only be justified in extreme cases, and when all the other sanitary measures have failed to suppress the extension of the contagion, as the inconvenience and hardship attending such a measure are generally very great. With a rigorous enforcement of the laws relative to reporting the existence of the disease, and isolation of the sick and suspected, and particularly with a thoroughly efficient sanitary service to carry these out, every contagious disease should be confined to the smallest limits, and promptly extinguished, without resorting to such a step as the prohibition of the movement of cattle, at least on certain conditions. When, however, circumstances demand such a measure, it should be quickly resorted to, as delay can only aggravate the evil. Fairs and markets in the infected localities, as well as in the adjoining districts within a radius of at least three leagues, should be suspended ; and if any persons dwelling in an infected locality transfer their residence to another, they should not be allowed to take their cattle with them.

The addition of slaughter-houses to markets and fairs held only for the sale of fat stock would permit these to be held, on condition that all the animals exposed for sale should be killed and dressed therein ; every precaution being adopted at the same time by the veterinary inspector.

9. *Prohibition of Buying and Selling.*

As a general rule, the sale of cattle belonging to an infected district, or which have come from infected stables, should be prohibited. In urgent cases, the greatest care should be exer-

cised that this prohibition is strictly carried out; and this can only be fully assured by taking the census of animals at different periods during the reign of the disease, and at the final enumeration.

These general measures may, however, receive exceptions in particular circumstances. With certain precautions, and under certain restrictions, the sale of fat stock, even when considered as suspected, may be authorized—provided, of course, that their flesh may be consumed without risk. In no case should the sale or slaughter of animals for food be permitted if they are suffering from, or are suspected of being infected with, a disease which renders their flesh dangerous for consumption: the different forms of Anthrax or Rabies, for instance.

Suspected cattle should not be allowed to be sold but to butchers, who must kill them without delay. They must not be disposed of to cattle dealers or breeders. Slaughter should take place in the same locality, and, if deemed necessary, the carcass should be carefully inspected; or the animals may be sent for this purpose to a neighbouring town or village, easily reached by rail. In the latter case they should be always accompanied by a certificate given by the authorities, indicating their number and particular description, and stating that they came from a contaminated locality, and must be immediately killed. A person in whom confidence can be placed, and who will be responsible for the strict carrying out of the instructions given to him, should accompany the cattle.

By authorizing the sale of the flesh of suspected cattle, without in the least neglecting any precautions necessary to avert the propagation of the contagion, the duration of the outbreak is diminished, as well as the losses which the malady might inflict on the proprietors.

When a contagious malady prevails, especially among cattle and sheep, their purchase should be checked; as the introduction of new stock into an infected locality must necessarily increase the number of animals capable of contracting the epizoöty, and therefore tend to prolong its duration.

The permission to purchase animals, and bring them into such a locality, should only be accorded to butchers; and these purchases ought to be duly notified to the authorities.

10. *Suppression of Grazing.*

In each locality where a contagious disease breaks out, it is necessary, as we have already stated, to prevent as much as possible, all congregating of cattle. Not only should the diseased as well as the suspected animals be isolated, but those still apparently healthy ought not to be allowed to frequent the pastures and common watering places, as this may tend to propagate the malady, should there chance to be an infected one among them.

Such a measure as this cannot, of course, be easily carried out at those periods when cattle and sheep-owners have no other means of keeping their animals than on pasture, or when other kinds of food are dear. In such instances, proprietors may be allowed to graze their animals on the common pastures, but each flock or herd should be allotted particular portions, and kept apart from the others. This should be particularly observed.

The straying of dogs, pigs, and poultry should be carefully guarded against in localities where very contagious maladies prevail, as they may aid in diffusing the virus.

11. *Notice to Neighbouring Localities.*

As soon as the existence of a contagious disease has been discovered in a locality, all the neighbouring localities should be immediately informed, and steps ought at once to be taken on receiving the warning to limit as much as possible all communication with that which is infected; the sanitary authorities should prescribe the precautionary measures.

12. *Occision, or Slaughter.*

Occision, or the slaughter of diseased, and perhaps also of suspected animals, when a violently contagious and deadly disease prevails, and more especially when it has just commenced to spread, is a most valuable, and, indeed, indispens-

able measure of public safety, and one which the community has every right to demand should be promptly resorted to for the general welfare. More particularly is its adoption necessary when the disease is incurable (as Cattle-plague or Sheep-pox), or difficult of cure (as Pleuro-pneumonia), and attended with great suffering to the sick animal. Even when the disease is not very fatal, but is embarrassing and subtle in its diffusion (as Foot-and-mouth disease), and costly by reason of the readiness with which it is propagated, the slaughter of those first affected is to be recommended before every other measure and in nearly every instance.

Intended to preserve the property of individuals, and sometimes even the health of mankind, and to avert from helpless animals an oftentimes lingering, painful, and fatal disease, occision becomes an essential act of indisputable public utility and salubrity, and should form a prominent feature in all legal enactments for the suppression of dangerous or harassing contagious diseases of every kind in the lower animals. As a humane measure it must hold a high place, because it diminishes the risk of a great number of animals being involved in suffering.

It also reduces to the smallest possible dimensions, when timeously resorted to, what might become a national misfortune. Witness the Cattle-plague in England in 1865-66. It is not improbable that the disease may have been introduced by one or two sick animals, and that within a few days it might have been extinguished by sacrificing a dozen or so, and resorting to ordinary precautions. Instead of this, at least 500,000 animals perished, and the pecuniary loss amounted to something like eight millions of pounds. Holland, infected by twelve or fourteen animals from England, followed our example, and lost more than 165,000 head of cattle; while Belgium, invaded on almost every side, but provided with a good organization, repelled the scourge at a very small sacrifice.

The measure has generally been opposed by those who know least of virulent diseases or the readiest means of extinguishing them, and has been sometimes designated by

those who should have been better informed, as unscientific, barbarous,* and a waste of property. It is neither. We have shown that if we can preserve five thousand or ten thousand animals from a painful and torturing disorder, by the sacrifice of one or two in the ordinary way in which they are killed for food, we are acting in a most humane manner, and more especially if the disease is incurable. The assertion that it is a waste of property is not founded on experience, and is incorrect. If five thousand animals run the risk of becoming infected by five diseased ones (which is not at all improbable), even with such an apparently simple malady as Foot-and-

* Medical writers even have entered the lists with those who have opposed this measure ; and indeed during the Cattle-plague in England they were the chief antagonists to its adoption. All kinds of arguments were brought forward to show that it was unscientific, and too barbarous to be entertained. Of course they did not understand its applicability and utility ; as such a means of extinguishing human contagions which are incurable, and sweep off thousands and tens of thousands of mankind, cannot be resorted to. And yet the humanity of such a measure in the case of the human species might at times be strongly urged. What a merciful act would it not have been for the unhappy Mexicans, to have made away with that Small-pox infected negro, instead of landing him among them in 1520 ! We must not forget that we sacrifice human beings who are *morally* diseased, if not physically, for the safety and welfare of society ; and that a surgeon does not hesitate to sacrifice perhaps a large portion of a man's body, in order to preserve the remainder.

Vicq d'Azyr, whose large experience of the Cattle-plague in the last century, made him a strong advocate for the slaughter of the diseased and suspected, mentions a medical author who expressed himself against it in these terms :—"What a horrible expedient is slaughter ! It is as barbarous as the name which expresses it. What would be said of the physician who, under the specious pretext of preserving human beings, would have counselled, during the plague at Marseilles for example, the stifling of the plague-stricken ?" Vicq d'Azyr, who was himself one of the most distinguished physicians of his time, replies that "we ought not to forget the immense distance that separates man from the brute, and that if we did not sometimes sacrifice a human life for the public welfare, we ought not the less to sacrifice animals without hesitation, when the interests—nay, the lives—of mankind would be compromised without this severe but indispensable measure." He might have added that slaughter is the inevitable destiny of these animals, but not of mankind ; and that we do not breed, rear, and fatten human beings to slaughter and eat them.

mouth disease), and from which not one of the five thousand would die, but which would reduce their value by two pounds each (not speaking of the trouble or expense of treatment), then surely it would be more profitable to kill the five, whose aggregate value might not be more than fifty pounds.

As to slaughter being an unscientific measure, it may be said that science has effected but little for the cure of many contagious diseases of man and beast. With all his skill and appliances, the physician cannot cure some of the most cruel and destructive maladies to which mankind is liable, but must stand looking helplessly on, or fruitlessly try one remedy after another, while they pursue their deadly course.* If such is

* The destruction of human beings affected with mortal and contagious diseases, is not unknown to some parts of the world. For example, Bruce makes us acquainted with its being had recourse to in invasions of that fearful scourge of the human family—Small-pox—among the Abyssinians :—

"In that flat district of Abyssinia called Maitsha, lying in the eleventh degree of north latitude, near the great lake of Tzana, such is the terror of the Small-pox—which comes here seldom more frequently than once in fifteen or twenty years—that when one of their houses is tainted with the disease, the neighbours, who know this contagion might infect the whole colony, surround the house in the night and set fire to it, which consumes it in a minute, whilst the unfortunate people belonging to it—who would endeavour to escape—are unmercifully thrust back with lances and forks into the flames by the hands of their own neighbours and relations, without an instance of one ever being suffered to survive. This to us will appear a barbarity scarcely credible ; it would be quite otherwise if we saw the situation of the country under that dreadful visitation, the Small-pox—the Plague has nothing in it so terrible."—*Travels*, &c.

In Arabia, the Small-pox is held in no less dread. "As soon as a person is attacked by it, he is immediately removed to a hut built in a lonely place—a kind of hospital, in fact, where there are servants who have already had the disease. The Bedouin Arabs are very frightened at this disease. A man of Birguid, named Othman, once related to me that, having had the disease, and having escaped danger, though his skin was still marked, he used to go out with his face covered with the cloth of his turban to protect him from the flies. One day, being thus veiled, a party of Arabs approached, and sent forward a man, who walked with a hesitating and uncertain step. When he was near he cried out, 'Tell me, I pray thee, if in this village there be any one ill of the Small-pox?' 'God

the case with the physician, who can resort to means of cure which the veterinarian, from pecuniary and other considerations, is denied, we should not be amazed that some animal maladies are beyond the reach of veterinary medical skill. This truth has been a long time in obtaining recognition. A cure has always governed every other consideration; and yet it was not known what we were to cure, nor in what way we should begin. The belief was that a cure would be found; and to minister to this belief, contagious diseases have been allowed to exist, in the hope that some day a specific would be discovered, while prevention was scarcely dreamt of. But as a distinguished writer says—"The attainment of truth, even though that truth be a negation of previous beliefs, is always

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preserve me,' replied Othman, 'from exciting in thee a dangerous security by a false answer.' So he uncovered his face, and the Arab fell at once to the ground with a great cry. His companions ran forward and carried him away, and Othman fled, or otherwise they would have killed him. He afterwards learned that the unhappy man died in three days. The people of Soudan have a curious idea as to the origin of the Small-pox. They pretend that it is brought by a little animal imperceptible to the eye, but which leaves evident traces of its passage on the ground. This insect fixes on the skin, and thus engenders the disease. I am told that its tract consists of a series of round points, disposed in a single straight line—so, ...—and they say that, whenever this tract is observed in the morning directed towards any house, the Small-pox infallibly appears there."—*Travels of an Arab Merchant in Soudan*, p. 117.

Humboldt states that this disease makes such cruel ravages in South America, that the natives, seized with dismay, burn their huts, kill their children, and renounce every kind of society.—*Travels*, &c., vol. ii. p. 248.

The Indians of Chili used to burn down the huts in which people who were suspected of Small-pox lay.—*Molina:* Essai sur l'Hist. Nat. du Chili, 1789.

And the Mongols, according to Timkowski, inflict *pecuniary* penalties on those who infect with this malady. "If a person with the Small-pox is confined in a strange house, and communicates the disease to another individual, so that death ensues, he is fined three times nine head of cattle; but if the person infected recovers, he is fined only nine head of cattle. If any one communicates to another a disorder, not the Small-pox, he must pay a horse."—*Journey to Pekin through Mongolia*, vol. ii. p. 344.

a matter of the highest importance to mankind, and one well worthy of strenuous labour."

We may be disappointed in not discovering a cure after what the attempts have cost; but this disappointment should be far more than compensated for by the knowledge that we have found a more humane and profitable means than medical treatment for virulent diseases, and one to which the physician cannot resort. The health and utility of the domesticated animals is far more of a pecuniary matter than that of man; and the arguments against occision have neither been logical nor sensible.*

The value of the measure has been, and is almost daily being, proved. It is only by it that we can readily and surely free ourselves from certain of the deadliest animal contagions, as Cattle-plague, Pleuro-pneumonia, Rabies, Variola, Glanders and Farcy, and maladies of that class. The history of Glanders in the British army is a most striking illustration of

* The veterinary student who is desirous of examining these arguments, as well as those in favour of the measure, will find them clearly and fully set forth in the following works :—

Vicq d'Azyr. Exposé des Moyens Curatifs et Preservatifs qui peuvent être employés contre les Maladies Pestilentielles des Bêtes à Cornes (Paris, 1776), p. 569.

Bourgelat. Sommaire d'un Mémoire publié en 1775.

Brugnone. Sommaire d'un Mémoire sur cette question très-importante : Convient-il, pour detruire dans un Pays la Maladies Pestilentielle des Bêtes à Cornes, d'y tuer toutes les Bêtes Malades et toutes les Bêtes Suspectes? Annales d'Agriculture, vol. xvi. p. 63.

Gilbert. Projet d'Experiences pour Parvenir, à la Connaissance de la Nature, de la Marche, des Causes, et du Traitement de l'Epizootie regnante. Annales d'Agriculture Française, vol. ii.

Guersent. Essai sur les Epizooties (Paris, 1815).

Dupuy. Maladies Epizootiques (Paris, 1836).

The great Haller, writing to Vicq d'Azyr on the 7th of September, 1777, says—"With regard to epizoöties, it is only with our neighbours that they can exist. Our method is to kill, without remission, all the infected cattle; and by this very simple means we have constantly prevented the malady from extending in our country, although our frontiers are always tormented; your frontiers, particularly, are so mixed up with our mountains, that there is extreme difficulty in keeping the latter free from contagion."

the great benefit to be derived from it. It is also a useful measure in those miasmatic diseases, such as Anthrax, which are, nevertheless, communicable like virulent maladies.

It is likewise sometimes necessary to kill an animal suffering from a suspicious disease, in order to establish a satisfactory diagnosis, and so be in a position to adopt prompt measures to preserve others.

Occision, then, is a radical measure for suppressing a contagion at its very origin, and with the least loss and cost. For every animal slaughtered, we may preserve a hundred from death, and perhaps two hundred from disease. The safety of the animals of a country may depend upon the promptitude and intelligence with which it is carried into execution; while delay, from ignorance, false sentiment, or interested motives, may lead to the most disastrous consequences. It is necessitated by the difficulties that frequently accompany isolation, the ignorance or dishonesty of owners of animals, the almost insurmountable obstacles to confining the virus to a stable, a pasture, or a locality, and the duration of the disease, as well as the vitality of the infecting element. It allows the contagion to be more certainly and quickly extinguished than by any other measure of sanitary science, and this in itself is an immense advantage to a country.

Occision is of two kinds—"partial" and "general."

(*a*) *Partial Occision.*—Partial or individual occision is, of course, most to be commended, and is that which may be adopted most successfully at the very commencement of a virulent disease. Sometimes it includes the suspected, as well as the diseased; at other times, the latter only. Animals which have cohabited with the diseased, and are to all appearance quite healthy, may also be included in this measure, and then we may have all the animals in a stable, a farm, or a village sacrificed. To kill only the diseased without including those which have been in contact with them, or at least isolating them, is useless and extravagant.

(*b*) *General Occision.*—This is a wide and terribly severe measure, for if rigorously carried out it means the slaughter of all the diseased, suspected, and healthy animals susceptible

of the disease in a given locality or district. It is rarely resorted to, and should never be required in a country in which there is anything like an efficient veterinary sanitary service.

It has been said that occision cannot be usefully resorted to when a contagious disease has made any great progress in a country. This is not correct. The history of the Cattle-plague in Britain and in Holland in 1866, and in France in 1870-71, proves that it may be the only effective means of suppressing the malady, even when it has attained a large development in a country.

Such a measure certainly should not be had recourse to except in the most serious cases, when public utility demands such a sacrifice ; but it ought not to be attempted unless compensation is given for the animals that must be slaughtered.

It should be made compulsory by the authorities, acting on the advice, of course, of the veterinary experts. On the latter falls the responsibility of diagnosing the disease ; and this in some cases may at first be very difficult. Nothing should be omitted by them that may tend to throw light on the subject, and the greatest circumspection should be observed in investigating the facts relative to the outbreak and the nature of the malady, in presence of the serious results that may follow. They should assist in carrying the measure into execution, if it has been decided upon, and an examination of the carcasses will generally confirm their diagnosis, if it is correct.

The mode of application of the measure depends upon circumstances. In the majority of contagious diseases, it is better to kill the animals without the effusion of much blood. The pole-axe, "pithing," or shooting a bullet or small shot into the brain, are generally preferred. In cases where the flesh may be utilized as food—as in Pleuro-pneumonia, and Foot-and-mouth disease—the animals may be slaughtered and dressed in the ordinary way.

13. *Choice of a Slaughter and Burial-Place.*

After the consideration of occision comes that of the proper place to carry out this measure, and also that of interment : both supplementary to the first, but of equal importance in many cases. In a veterinary sanitary point of view, the care-

ful interment of diseased carcasses is intended to destroy the infectious germs—a kind of disinfection, in fact; it has been found of the greatest utility, and in some countries it is rendered obligatory for all animals which have died from, or been killed in consequence of, contagious diseases. Such is the case in France. In Germany, burial is not insisted upon as a general measure for all the contagious maladies, there being particular regulations with respect to each disease, defining when and how it should be done—as in Cattle-plague, Anthrax, and Rabies. In Bavaria, in the particular regulations laid down for the guidance of knackers, there is mention made of interment; and in Austria and Switzerland there are special regulations for each disease. The regulations in force in this country will be found in the appendix.

Interment should only be obligatory in certain circumstances, and when no other course is considered safe. In such a case as Cattle-plague, for instance, it can scarcely ever be dispensed with, and should, therefore, be rendered compulsory; for it is, above all things, essential to get rid of the contagious element with all speed, and this is the most prompt and economical course.

The utilization of the carcasses—and especially of the flesh—can only be permitted in special diseases, which will hereafter be specified.

Interment is more particularly necessary in villages and the country, where there are no proper knackers' establishments, and especially in such maladies as Cattle-plague, Sheep-pox, Anthrax, Rabies, &c.

If in the vicinity of the infected locality there is not a knacker's establishment, where the carcasses of the slaughtered animals, or those which have perished from the disease, may be readily removed for utilization without risk, a place should be selected which may serve for interment, as well as for slaughter.* This place should be isolated, not too far from

* It is curious to find that in this country an animal suffering from a very contagious disease may be driven for miles along a road to a slaughter-house or knacker's establishment, to be killed, and may in this journey contaminate scores of other animals; while the merely suspected

the locality, and if possible no roads should communicate with it; neither should it be frequented by animals, and it ought to be three or four hundred yards distant from any human habitation. Care should be taken that, during the removal of the living animals to be slaughtered, or the transport of the carcasses of those which have died, no animals likely to be infected are in the way; and if the ground has been soiled by dejections, blood, &c., these should be carefully removed, as well as the superficial soil, and carried to the burial-place. In the case of bovine diseases of a very contagious character, horses only should be employed to transport the carcasses; and these ought, if possible, to be conveyed in box carts, lined with a tarpaulin, to prevent contagious matters falling through and soiling the roads or pastures, and also to keep the carts free from blood and infectious discharges. Knackers or other people accustomed to handle carcasses should, if possible, be obtained to conduct this removal.

If the necessity for establishing lazarets arises, the most convenient situation for their construction will be found near the burial-place; as the cost, trouble, and danger of conveying the dead there will be greatly diminished.

The choice of soil is not a matter of indifference. Chalk, gravel, or sandy soils, when they permit the pit to be made sufficiently deep, are preferable to those of a clayey nature. Damp places, those near rivers, or which at certain seasons are submerged, should not be selected. No fixed rule can be laid down as to the depth to which the pits should be dug, as this will depend upon the nature of the ground, its compactness, the number of animals to be interred, &c. At least five or six feet of soil should cover the carcasses, and if the pit cannot be dug sufficiently deep to ensure this cover-

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are rigorously confined to their stables or pastures! Our sanitary regulations abound in such paradoxes. A cattle owner in Norfolk, for instance, among whose animals contagious Pleuro-pneumonia has broken out, may send them to the London market as fat stock, purchase them there again, and bring them home with impunity. There is a regular traffic in cattle either suffering from this disease, or contaminated by association with them.

ing, then the earth ought to be banked upon them in the form of mounds.

When the entire carcass—hide, flesh, horns, &c.—is to be interred, the skin should be well slashed and cut about, when in the pit, and the flesh mutilated and soaked with tar, if there is reason to apprehend that it will be disinterred. Sometimes disinfecting matters are thrown over the carcasses, such as lime, sulphate of iron, ashes, &c.; these are useful in sandy soils, but not in clay, in which they hinder putrefaction. When the pit has been filled in, the soil should be well trodden down, and covered, if necessary, with thorny bushes and stones, with the view of preventing as much as possible dogs and other animals from burrowing into it and dragging away pieces of flesh. It may even be necessary to post watchmen round the pits—shepherds, cowherds, and others. The situation of the burial-places should be notified to the public by posts, branches of trees, placards, an enclosure of any kind, a quick-set hedge, &c. This is more particularly necessary in such virulent diseases as Cattle-plague and Anthrax.

The soil covering the graves should not be employed for agricultural purposes for a certain time after interment, varying with the vital tenacity of the virus. Kœrber and Haubner mention cases in which fodder grown on graves that contained the carcasses of animals which had perished from Anthrax, infected healthy animals. Zundel recommends that a period of three years should elapse before the ground is so interfered with.

Into pits should also be deposited all débris of such animals, the earth soiled by them, their excretions, the forage tainted by them, litter, &c.

The opening of the pits—to utilize the bones, for instance—should not take place within five or six years — Röll says eight to ten years; it should not be done without the permission of the authorities.

On these burial-places the disinfection of skins, horns, hoofs, the melting of tallow at a high temperature, and the removal and disinfection of bones from the carcasses—when this is permitted—should be carried out. All the necessary utensils

must be carried there, and the people who are occupied in this way must not be allowed to go near healthy, nor even suspected, animals, nor have any intercourse with the inhabitants of the locality. Men in whose integrity confidence can be reposed, should see the regulations scrupulously carried out.

14. *Utilization of the Carcasses of Diseased Animals.*

The utilization of the carcasses of animals which have perished from, or been slaughtered for, contagious diseases is a grave question, and one which demands the closest consideration. We will discuss it at some length in describing the special diseases, and need only now briefly notice the utilization of the flesh, skin, horns, hoofs, tallow, and bones; for these are, of course, of considerable value, and in a widespread epizoöty it may be a matter of serious loss to the community should it not be possible to utilize them.

(*a*) *Flesh.*—In some contagious maladies, as Anthrax, Glanders and Farcy, Tuberculosis, and some parasitic diseases, &c., the flesh should on no account be used as food without the greatest precautions as to thorough cooking; and not even then, unless from extreme hardship, as the risk of injury is too great. In other diseases, such as Cattle-plague, Pleuro-pneumonia, &c., though the flesh is innocuous as food, yet the danger of diffusing the infection by preparing and carrying it about is too evident to be overlooked. Means of disinfection, and other precautions, might, nevertheless, in certain circumstances, and more especially in Pleuro-pneumonia, render the utilization of the flesh quite safe; and thus would the loss incurred by the slaughter of animals in good condition be materially diminished.

In other contagious maladies, the contagium which is localized in certain organs, quickly loses its vitality, and does not affect the flesh, no precautions are necessary beyond, perhaps, allowing the carcass to become quite cold and well aired before it is allowed to be carried away from the slaughter-house.

It is greatly to be desired that, in utilizing the flesh of animals affected with contagious diseases, their slaughter and the dressing of the carcasses should be effected on the spot

where they are discovered to be diseased, or in some secluded place near their dwelling, so as to avoid the risk attending driving them to slaughter-houses.

(*b*) *Skins.*—The utilization of the skins may be sanctioned in all contagious bovine maladies except Cattle-plague and Anthracoid affections; and in these they might be made use of if sufficient precautions could be adopted against the transmission of the infection. In the equine species, Glanders and Farcy are the only formidable diseases which render the utilization of the skins dangerous; but even in these, with due precautions, their use might be sanctioned. The same might be said of Scabies and Variola of the ovine species, which render the utilization of the skins dangerous unless care is taken.

In Rabies, no matter what species of animal may be affected, Röll recommends that the skins be not utilized.

With care on the part of the knacker, however, and if worth the risk, there is no reason why they should not be rendered innocuous.

Should it be decided that skins are not to be utilized, they ought to be extensively slashed before burial.

The measures for rendering skins harmless should be undertaken in the locality where the contagious disease prevails, or as near it as possible; in which case precautions must be adopted in transporting them. Steeping in lime-wash, or a solution of wood ashes, for twenty-four hours, and drying in a current of air for eight days, is a ready measure. It is made more effective if they are smoked, by burning straw or wood under them several times during this period. Or fresh skins previously damped, should they be dry, may be exposed to sulphurous vapours, and then suspended in a current of air for eight days, on poles. The fumigation may be done in pits boarded over to keep in the vapour for at least a quarter of an hour.

(*c*) *Horns and Hoofs.*—Röll recommends that these be steeped for twelve hours in a solution of sea-salt, then well washed and dried.

(*d*) *Tallow.*—This may be melted and preserved in jars or other receptacles.

(*e*) *Wool.*—The wool from sheep suffering from, or suspected of, a contagious disease, must not be sold or utilized until it has been carefully washed, dried, and aired. It may be rinsed in a solution of carbolic acid.

(*f*) *Bones.*—In localities where a contagious disease has made great ravages, the value of the bones of the animals which have succumbed may be considerable. After their thorough disinfection, their utilization may be permitted by the authorities, with whom this responsibility should rest. Indeed, the authorities ought to assure themselves that the disinfection has been carried out properly, and that the regulations with regard to the disposal of the other parts of the carcass are not infringed.

As has been already stated, all these operations should be carried out in the place assigned for a burial-ground, which ought to be strictly watched while they are taking place.

None of the products mentioned, except the flesh, should be allowed to be sold until after the official declaration that the disease has ceased in the locality; and, if possible, knackers should conduct the various operations alluded to, receiving payment for the same.

We shall allude to disinfection as a sanitary measure, as well as the manner of carrying it out, presently.

15. *Compensation.*

Compensation is the counterpoise of compulsory slaughter. Occision is, as we have just seen, the most certain and prompt means of extinguishing a contagious disease, and, generally, the most economical. But unless compensation is given to the owners, it is a hardship and an injustice to resort to this measure, and leads to every kind of deception and evasion. Indeed, it cannot be otherwise. A contagious disease invades the stable or cowshed of a poor man; if its existence becomes known, the animals therein, which may constitute his entire fortune, will be slaughtered to prevent the extension of the malady, and he will be ruined. As a matter of self-preservation, therefore,

for himself and family, he conceals the outbreak, to the imminent danger of his neighbours' animals, and perhaps to those of a whole county ; and dreading loss from his stock dying of the disease, he clandestinely disposes of it as best he may, sending the sick or contaminated beasts to markets, whence they may introduce the contagion hundreds of miles away. In acting thus, he cannot be greatly blamed. The compulsory slaughter of the whole of a farmer's stock in some districts would be utter ruin to him, and he is certainly excusable in endeavouring to avert such a catastrophe, especially if the disease has just manifested itself. If he cannot quietly dispose of the animals in the market or elsewhere, even at a sacrifice, he has every reason to believe that they will not *all* die *if* left to nature ; and whatever number may remain will keep him from beggary. He will not so much consider his neighbour's loss from the spread of the contagion as his own, under such circumstances ; for there are but few men who would destroy their own fortune to preserve that belonging to others.

If the destruction of an individual's property is necessary for the public welfare and in the interests of society, then certainly the public should recompense him to the full value of that property. Occision, as a legal measure, without compensation, will never be tolerated in a country like our own ; or if it is, it will only lead to fraud and concealment of disease—both of which are most potent agents in spreading it.

The expropriation of an owner's horses, cattle, or sheep for the purpose of slaughter being, then, a measure of the greatest public utility, mere justice, to say nothing of policy, demands that public compensation to the integral value of every animal so sacrificed be awarded. The more liberally and equitably this is carried out, the more likelihood is there of obtaining every assistance from those whose aid is always of the utmost moment—the proprietors. Of the truth of this, history affords abundant evidence, even in our own country.*

* It was truly astonishing to find Members of Parliament, when this measure was proposed during the existence of the Cattle-plague in this country in 1865-66, oppose its adoption most vehemently, merely, it would appear, because it was a measure of fairness and justice to the agricultural community.

In all cases, therefore, in which animals are destroyed by authority, with the object of preventing the extension of a contagious disease—no matter what the malady may be—compensation should follow. The other sanitary measures are rendered easy and effective, especially those which are most essential—declaration and isolation.

The amount of compensation will vary, of course, according to circumstances, but it must always be equitable, and the full market value of the animals should be allowed. It is better to err on the score of liberality. For animals which are healthy or only suspected, a higher rate will be given than for those which are diseased, and might probably die or be a long time in recovering.* This will be decided at the valuation. The authorities should nominate an expert for this purpose, and the proprietor might, if he desired it, designate another. The utilization of the carcass, or any portion of it, must be considered in this valuation.

Beneficial and just as is the awarding of compensation, it nevertheless requires care, as dishonest persons may take advantage of it to impose upon the authorities, and without a good veterinary sanitary service it cannot be resorted to without more or less of fraud being perpetrated. Dishonesty and fraudulent intentions should be severely punished; and any attempts at concealment of disease, or clandestine traffic in diseased animals, should meet with the heaviest penalties, as there is no excuse for it when liberal compensation is allowed.

A distinction should also be made in the case of those owners whose animals become diseased from no oversight or carelessness of their own, and those who, from neglect of ordinary precautions, carelessness, or interested motives, allow infection to appear among their stock. While the former have every claim to compensation, the latter certainly do not deserve it. Damages and expenses caused by the measures adopted should also be compensated for.

* With Glanders and Farcy—diseases which are incurable, and sooner or later terminate in death—full compensation need not be given; partial indemnity may, however, be allowed, in order to induce the owners to declare the existence of the maladies.

16. *Employment of Policemen.*

The functions of policemen in the suppression of contagious diseases should be limited to assisting in carrying out the prescribed measures; such as maintaining the necessary isolation, seeing that the slaughter and burial of infected animals is conducted according to the directions of the veterinary inspector, and to take care that none of the measures are violated in an infected district or locality. They should also watch the movement of animals; but they ought not to act as inspectors. This is a function they are incapable of performing with any advantage to individuals or to the public; indeed, their being entrusted with such a duty is positively vexatious and dangerous. They may, nevertheless, assist the veterinary inspector in the detection of diseased animals and clandestine traffic.

It is scarcely possible that the military will ever be called upon in this country to assist the police in carrying out the necessary sanitary measures, as so frequently happens on the continent; liberal compensation, and acquainting those whose interests are at stake with the nature of the malady and the necessity for suppressive measures, will always be sufficient to obtain the support of all concerned. But whether policemen only should be required, or whether they are assisted by soldiers, they should receive clear and detailed instructions as to the duties they have to perform in the infected locality.

DISINFECTION AND DISINFECTANTS.

"Disinfection" (from *dis*, to separate from, and *inficio*, I infect) may be defined as a sanitary measure which has for its aim the removal, alteration, or destruction of the organic agents that cause infection, and with which the atmosphere, different materials, or the bodies of sick or healthy creatures may be impregnated; while "disinfectants" may be designated agents which, by a physical, chemical, or physiological action, neutralize, destroy, or otherwise render innocuous these organic matters, though the term is sometimes employed for agents which also arrest decomposition and remove offensive gases, and includes any substance possessing deodorizing, antiseptic, or oxidizing properties. Properly speaking, disinfec-

tants should only include those agents which aid in hindering the extension of infectious maladies, by altering or destroying their specific contagia.

Infection, as we have seen, is sometimes due to the putrid decomposition of organic matter; at other times to those elements of an organic nature not yet properly defined, and which we designate as a virus, contagium, miasma, &c., or to living animal or vegetable parasites. But modern discoveries tend to limit infection to two kinds: "parasitic" and "septic." So that therapeutic disinfection may be parasitic or antiseptic as the case may require, or more frequently it may be both at the same time. Septic infection being, however, limited in its morbific effects, if the results of recent researches are fully confirmed, disinfection will chiefly resolve itself into a war with the most minute living organisms. However this may be, we cannot omit to include parasitism among the infectious or contagious maladies, as practically the transmissible parasites are nothing more nor less than a fixed virus, a contagium.

Measures of disinfection are sometimes applied to the animal body which has become infected, sometimes to the place it inhabits, to the media with which it has been in contact—the atmosphere surrounding it, and the bodies in contact with it—harness, clothing, &c.—and at other times to the food and drink. All these bodies may, in consequence of their more or less intimate relations with infected animals, communicate infection to those which are healthy; and it is more particularly in this respect that the subject of disinfection has to be treated in this section, each infectious malady demanding its special measures, which will be noticed in describing these.

Sanitary disinfection, then, speaking generally, only applies to mankind and animals which have been in contact with infection, that of carcasses and animal productions—such as skin, bones, tallow, wool, &c.; localities—such as stables, sheds, pastures, &c.; waggons, utensils, harness, clothing, forage, &c., as well as the air and water so contaminated.

Disinfection is a sanitary measure which should be rendered obligatory by general or special regulations in infectious diseases, and the district veterinary surgeons should see to its

being thoroughly carried out by the owners of infected animals, who ought to be held responsible for the supply of the requisite materials, and afford all necessary facilities; the details of disinfection being left to the judgment of the veterinary surgeon.

Disinfection is a very difficult operation to carry out effectively, if we examine carefully the nature of contagia; and it demands the most minute precautions, if we would energetically destroy these, and yet not damage the health of the tainted animals. It is a very important operation, because of its eminently practical features; and it is so frequently rendered necessary by administrative regulations, that it should be understood and performed by the public; and it is rendered a delicate operation by the fact, that it is applied to animate and inanimate objects, often at the same time.

We have yet much to learn with regard to disinfectants and disinfection, and veterinary surgeons have an excellent opportunity afforded them of advancing our knowledge of both by direct, experimental, or accidental observation during the prevalence of contagious diseases. For it is among animals, rather than in the laboratory, that reliable information is to be obtained; and in observing the action of different disinfectants on the bearers of contagia, or vehicles by which the virus is conveyed, than by entering into researches on their influence on germs which may probably have but little relation to the viruliferous agents of these maladies.

Everything relating to general, and even sometimes to special, hygiène must be taken into consideration by the veterinary surgeon who is about to resort to this measure, which requires an intimate knowledge of chemistry, physics, materia medica, and sometimes of pharmacy; as well as an acquaintance with public and private customs, and local circumstances. Its value depends upon the energy and carefulness with which it is adopted and carried out.

Disinfection may be accomplished by (1) the destruction of infected objects, (2) their purification by mechanical means, (3) by a physical or chemical procedure.

The first of these means is the most certain, but it is

one which should not be resorted to except in very urgent cases, as it is generally the most costly. The second, more particularly, requires time, in order to ensure the destruction or dispersion of the infecting agents ; and demands, besides, a concurrence of diverse circumstances to ensure the efficiency of the operation. In the majority of instances it is not preferable, though it may be more economical, than the next measure.

The third means is based on the supposition that the destruction or alteration of the vehicle of the contagium destroys the potency of the latter; and the various agents employed with this object differ widely in their action, not only according to their nature and composition, but also as to the manner in which they are applied. Some merely remove the aqueous constituents from the vehicle, and thus render the contagium inert by desiccation ; others coagulate the albuminous matter ; others act as oxidizing or deoxidizing agents ; while others, again, alter the properties of a virus or vehicle, by entering into chemical combination with them, robbing them of one or more of their elements, &c.

It may truly be said that no single agent can be exclusively relied upon as a general disinfectant. It is, therefore, better to employ different agents (taking care that they do not neutralize each other's effects), according to the circumstances and indications of each case, and also according to their known action. And, after all, it must be confessed that our notions of disinfection are still far from being exact, so far as the facts upon which their action is based are concerned : knowing, as we do, but little of the infecting elements we have to contend with. Only too frequently we find ourselves obliged to rely on hypotheses to explain the manner in which disinfectants exercise their influence, as in the majority of cases the viruliferous agents are not apparent to our senses.

Disinfection, generally considered, is studied with regard to its application to contaminated bodies, and the air which has been tainted or rendered infectious by diseased animals, or the " bearers " of infection. Deodorizing and antiseptic agents are frequently included among disinfectants.

We will, therefore, first proceed to (1) a consideration of the

disinfecting agents, and (2) their application. The disinfecting measures to be applied in each disease belong to the section which treats of these maladies in particular, and will, when necessary, be noticed therein.

Disinfectants.

"Disinfectants," then, may be said to be agents which destroy, or render innocuous, different kinds of contagia which produce disease, and in this way they might be made to include those which kill animal and vegetable parasites *(parasiticides)*, as well as virus *(antivirulents)*, miasmata *(antimiasmatics)*, and arrest putrefaction *(antiputrescents)*. The term is generally applied to any agent which possesses antiputrescent, deodorizing, and fixative qualities. With regard to their value as antivirulents, it may be said that our knowledge of them is based chiefly on experience of their effect in arresting the extension of a contagious disease.

The disinfecting agents are numerous and extremely varied, not only in their composition, but their action. We will enumerate the principal, and glance at their application and probable value. It may be observed, however, that we are provided with wonderfully potent purifying agents by Nature: these are diffusion, dilution, dispersion by winds, oxidation, and the action of rain.

1. *Heat.*

Heat is the most potent and valuable of all the disinfectants, and has been recognized as such from the earliest times. A temperature which coagulates albumen (180° Fahr.) is sufficient, in most cases, to destroy infusorial life, viruses, and miasmata, though it should be continued for a certain time. The virus of Vaccinia loses its potency when exposed to a temperature of 140°, and that of human Scarlatina is inert after being heated to 204°.

Renault found that all the carriers of contagia, when submitted to the temperature of boiling water, are no longer capable of producing disease.

Boiling water has long been recommended as an energetic and economical disinfectant for all those articles and objects

that cannot be submitted to fire or to the action of powerful acids, without injury. Steam has been also recommended with this view. Parasites are all destroyed when exposed to the full action of boiling water. When poured on the ground, however, it quickly cools, and cannot then be so much relied upon.

Drying at a certain temperature also contributes to destroy viruliferous agents in many cases—as in disinfecting hides, wool, hair, hoofs; and baking in a stove or oven has been practised when infected articles might, by other means, be damaged or less thoroughly purified. Tallow and suet are most certainly disinfected by melting, and so are iron objects by passing them through the fire of a forge.

2. *Cold.*

Cold is only an antiseptic and disinfectant when it is extreme, but we know nothing positive as to the low temperature which must be reached to ensure purification. Some infections have a wonderful power of resisting the action of cold, and according to Knock some parasites will withstand 10° Cent.; we have elsewhere given other instances. Some miasmatic and contagious maladies are in no way affected by the cold of winter.

3. *Air.*

The atmosphere, which is so frequently an active agent in assisting in the extension of contagious and malarious maladies, as well as pernicious gases, is nevertheless an excellent disinfectant. It acts mechanically, by diffusing or diluting the contagia; physically, by removing from them their moisture; and, chemically, it modifies the products of decomposition, oxidizing them, and rendering them harmless. But to act in this way it must be frequently renewed.

Alone, the air is capable of disinfecting skins, horns, clothing, &c., when these are fully exposed to its action. It is not possible to state the length of time necessary for this, as so much depends upon whether the air is humid or dry, the existence of winds, the resistance of the virus, and the nature of its medium. It is admitted, however, that exposure to the

air for fifteen days at a stretch is usually sufficient. Renault, by a number of varied experiments, has proved that for Glanders, Anthrax, Variola, and Rabies, a desiccation in the air of from twelve to fifteen days completely annihilated their contagia, the media being no longer capable of inducing these maladies by inoculation. Imperfect aëration or exclusion from the air, frequently, on the contrary, preserves contagia.

With an infected stable, with a view to the expulsion, diffusion, and destruction of the virus, we open the doors and windows, so as to allow a continuous current of air to pass through, and all obstacles to this constant draught in the shape of partitions, &c., are often removed to facilitate the operation; fires are also sometimes lighted to increase the current.

4. *Sunlight.*

Sunlight is a powerful agent in destroying animal poisons; and some infectious matters, if we are desirous of preserving them (as for inoculations), must be protected from it. Snake poison, for instance, is said to be destroyed by sunlight; though dilution may temporarily render it impotent, yet evaporation will restore its properties. But sunlight, independent of temperature, irrevocably destroys it.

5. *Water.*

In its disinfecting power, water resembles the atmosphere: acting mechanically in diluting and carrying away infectious matter, and in this way it is very useful. Water, also, by reason of its endosmic action, is inimical to the supposed corpuscular structures of many specific contagia, and, by rupturing their cell-like envelopes, destroys their vitality. Its properties in this respect, however, are generally increased physically or chemically, to enable it to act more directly. For instance, it is used hot or boiling, or contains chemical substances—as alkalies, chloride of lime, carbolic acid, &c.

6. *Rain and Dew.*

Rain is esteemed a good disinfectant in many cases, its in-

fluence in extinguishing some diseases being remarkable. It is one of Nature's disinfectants. Damp clothes have long been known to disinfect the air; and a jet of steam thrown into an apartment is not only of service from the heat it contains, but also for entangling and throwing down any floating matter and fixing gaseous substances. Certain fumigations of dry gases have no effect unless moisture is introduced.

Bleaching by the rain, or exposure to the air and dew, are generally considered a good means of disinfection. Indeed, some authorities have stated that they are so potent in destroying contagious matters, that a pasture which has been frequented by animals affected with Variola or Aphthous fever, may, after being subjected to the morning dew, be occupied by healthy stock without danger of infection. In this way tainted or suspected forage, straw, &c., which cannot otherwise be purified, may be rendered harmless.

7. *Ozone.*

Ozone has been recommended as a disinfectant, from its well-known oxidizing qualities and deodorizing properties. It is prepared by mixing very gradually three parts of strong sulphuric acid and two parts of permanganate of potassium. The amount of ozone can be measured by the common ozone paper, and the stopper put in if the tint is too deep. It may also be procured by half immersing a stick of phosphorus in tepid water in a wide-mouthed bottle; or by heating a platinum wire in a Bunsen cell (Parkes). In some cases of contagious disease in the lower animals, ozone may be resorted to as a disinfectant; but other agents will be found, if not more effective, at least more readily and more abundantly at hand.

8. *Acids.*

Strong acids, or a body causing acidity by chemical affinity —chlorine for instance—are destructive of organic matters, and therefore *à priori* of zymotic poisons.

They are chiefly mineral, though there are two or three organic acids which are employed as disinfectants. They

are *Nitric acid, Nitrous acid, Sulphuric acid, Sulphurous acid, Hydrochloric acid, and Chromic acid; Carbolic acid, Cresylic acid, Acetic acid, Picric acid, Benzoic acid, and Tannic acid.* The vapour of nearly all of these is irritating and injurious to the air-passages of animals.

(1.) *Nitric Acid.*

This acts as a destroyer of organic matter by oxidizing it. It is more particularly used in fumigations as a gaseous disinfectant, by treating nitre with sulphuric acid or by heating nitric acid in a suitable vessel. It requires care in its application, and if it is to be employed in the gaseous form all animals should be removed, and the doors, windows, and other openings well closed, the disengagement of the gas continuing in sufficient quantity for eight to ten hours, after which the place should be well aired. It has the disadvantage, like other acids, of acting upon metals, and also the walls of buildings, particularly the lime and plaster.

(2.) *Nitrous Acid.*

This is produced by adding strong nitric acid, diluted with a little water, to copper filings; or putting a piece of copper in these fluids. Reddish fumes are given off, due to the nitrogen dioxide evolved taking oxygen from the air. It is a powerful disinfectant, a property it apparently owes to the readiness with which it parts with oxygen to any oxidizable substance; its action on organic matter is well marked, and no agent will more readily remove the offensive odour of putrefying carcasses. It is very irritating to the lungs, and if it is to be used freely and efficiently, all animals should be removed, and the doors and windows closed; after disinfection the building should be well aired. If it must be employed in inhabited stables, it should be disengaged slowly; this is insured by diluting the acid with water to the required degree.

(3.) *Sulphuric Acid.*

When concentrated, sulphuric acid destroys organic substances, and is a good disinfectant of urine and fluid matters.

Its action is greatly increased by the intense heat engendered on its meeting with water ; it also fixes ammonia. Its fumes are too heavy to be useful.

(4.) *Sulphurous Acid.*

This is most readily produced by burning sulphur on a plate of metal, charcoal, or in an earthenware pipkin or other vessel that will withstand the heat. It decomposes sulphuretted hydrogen, and, by its combining with ammonia, it is a powerful deodorizer. It has been supposed to act powerfully on organic matter, and also on disease-germs. It is a very elastic gas, and rapidly becomes diffused ; for this and the reasons just stated, it has been employed as a disinfectant and deodorant. It also irritates the respiratory organs, and can only be employed in empty stables. The density of the gas is considerable, for its specific gravity is 2·24, or very nearly two and a quarter times that of air ; a cubic foot of the gas, therefore weighs a trifle less than 1206 grains, and it takes 603 grains of sulphur and a cubic foot of oxygen, representing five cubic feet of air, to produce it. Its chief characteristic is its powerful odour ; for as little as one part or volume of the gas in 100,000 volumes of air, is readily discoverable by the nose ; nine parts of it in 100,000 of air are disagreeable and provoke coughing ; twenty parts of it in that quantity of air are powerfully irritating ; and forty-three parts of it in 100,000 of air, or rather more than four parts in 10,000, are actually irrespirable ; but a much smaller quantity than this will rapidly kill plants. Water absorbs from forty to fifty times its bulk of the gas, and produces a solution possessing powerful antiseptic and disinfecting properties. The same is the case with the combinations of the acid with alkalies, forming the sulphites and bisulphites (Letheby).

(5.) *Hydrochloric Acid.*

The vapour of this acid has sometimes been employed in fumigations, and is by some authorities preferred to nitric acid, as it is more expansible and spreads quickly. It is, however, inferior in this respect to chlorine. When mixed with

fœtid matter, it combines with the ammonia and acts as a deodorizer.

(6.) *Chromic Acid.*

This appears to be a good disinfectant, but its expensiveness precludes its employment in veterinary practice.

(7.) *Carbolic Acid.*

This acid is extremely valuable as an antiseptic agent, and has been much extolled as a parasiticide, and to some extent as a disinfectant. It coagulates albumen and matters resembling it, and hinders the development of infusoria in infusions; hence its action as an antiseptic and parasiticide. It also acts as a deoxidizing agent, and causes the formation of ozone in the air. Its value in destroying effluvia, miasmata, and contagia is chiefly based on its antiseptic properties, and especially from its effects on bacteridia, whose development in putrid blood it prevents. It has been the subject of many researches, and by one series of observers its antivirulent properties are well defined and valuable. The experiments of Franck and Gerlach, for instance, prove that carbolic acid renders the virus of Glanders and Farcy innocuous; Ledru has shown that it has also this effect on the contagium of Sheep-pox; and Schönbein demonstrated that the same result was obtained with that of human Variola and vaccine matter.

It conceals all odours, according to Parkes, though it will not destroy sulphuretted hydrogen if it exists; it lessens the rapidity of putrefaction of animal substances suspended in a room, and they also dry faster, according to Langstaff. It also rapidly arrests the growth of fungi, though it will not completely destroy them. The small growing cells suspended in the air are checked in their growth, according to Trautman; and, in fact, the action of carbolic acid may be said to be the restraint of putrefaction and limitation of growth of low forms of aërial life (Parkes).

According to Dougall, it requires one part of the acid in 267 of an organic solution to arrest the development of animalcules for six days; and the addition of one part to 200 parts

of a solution swarming with infusoria had no injurious action on them. Air saturated with the vapour of the acid, at ordinary temperatures, had no destructive effect on the vitality of vaccine lymph after exposure to it for twenty-four hours ; and even when mixed with the lymph in the proportion of one per cent. and allowed to dry, the activity of the virus was not impaired. Pettenköfer has shown that, although carbolic acid will arrest the development of ferment cells, it does not destroy their vitality ; for if, after such treatment, they are freely diluted with water, they again start into activity. Parkes put some fresh fæcal matter, free from urine, in a bottle, and drew air, washed in strong sulphuric acid, over it ; fungi appeared rapidly on the fæcal matter. Air impregnated with carbolic acid was then passed over the fungi, and they became discoloured and apparently died ; but on again substituting washed air, they revived. The rapid destruction, and the as rapid re-growth, could be repeated many times, and evidently showed that the carbolic acid had withered, without actually killing, the fungi.

According to Calvert, the presence of one part of the acid in 1000 of an organic solution will check decomposition, and prevent the appearance of vibrio or fungi for more than forty days. Devergil observed in the Morgue in Paris, during hot weather, that one part of carbolic acid (No. 5, which contains eighty-five per cent. of carbolic and cresylic acids) in 1900 of water, freely applied to the dead bodies, completely prevented putrefaction ; and even when diluted to the extent of one part in 4000 of water, the effect was most marked. Letheby has observed that a very small quantity in the sewers of London prevented decomposition, and that a solution of one per cent. upon meat arrested putrefaction.

The mode of employing carbolic acid differs considerably. When used as a fumigant, special vaporizers have been employed, by means of which the acid falls drop by drop on a heated metal plate. The vapour is given off when the solid acid is placed in a saucer, or when the liquid acid-and-water is sprinkled about. A more rapid method, however, of vaporizing it is to allow one part of the acid and two of ether to

evaporate ; alcohol, also, when added to the water, will hasten its diffusion in the air with more or less rapidity, according to the quantity added. In the latter form, or even dissolved in water alone, it is extensively used as a disinfectant for the walls and woodwork of infected stables, harness, utensils, clothing, &c., after these have been thoroughly cleansed. It is often added to other washes. Zundel recommends it to be thrown into the air of stables by means of a suitable syringe. It is a very safe disinfectant to employ in inhabited buildings, and indeed it is almost the only preservative agent that can be recommended when a contagious malady prevails in a locality ; but it must be used in sufficient quantity.* It may be sprinkled over the floor ; kept in saucers or troughs containing sand, and placed near openings through which there is an inward current of air ; clothes saturated with it may be suspended in different parts of a stable ; it may be placed in the drains ; and the skins of diseased or healthy animals may even be impregnated with it—a weak solution in glycerine and water (1 to 100) being useful when applied daily to the surface of the body.

It has frequently been inhaled by cattle as a preservative or curative measure in contagious Pleuro-pneumonia ; clothes steeped in, or sprinkled with, a solution of the acid being suspended near their nostrils. This inhalation does not appear to do the animals any injury.

Similar management has proved equally effective with Foot-and-mouth disease. Finlay Dun says : "Several instances

* It is difficult to measure its action, as it decomposes solution of potassium permanganate, which cannot therefore be used as a measure of the organic impurity of air when carbolic acid vapours are present. Sansom has shown that when the acid evaporates, one grain is taken up at different temperatures by the following amounts of air :—By 320·75 cubic inches at 50° Fahr., by 159·44 cubic inches at 60° Fahr., and by 93·75 cubic inches at 70° Fahr. Langstaff has invented a trough containing flannel wetted with water and carbolic acid (one of acid to twenty of water), which is placed in the inlet ventilating tubes of a room ; he found that at a temperature of 57° four ounces of water are taken up in twenty-four hours, and that this will keep the air of an apartment, 22 × 10 and 11 feet high, thoroughly impregnated with the odour (Parkes).

have come under my notice, where Foot-and-mouth disease of a virulent type has been arrested after a portion of the herd had been attacked, by washing twice a week the walls, floors, doors, and other wood-work of the infected premises with carbolic acid ; confining the animals for several weeks to their sheds or boxes, and keeping them surrounded by and breathing an atmosphere abounding in the tar acids, freshly evolved by sprinkling McDougall's powder daily over the floors and manure." He also reports that the progress of Influenza in large stables has been greatly abated, and the virulence of the disease mitigated.

In empty stables, the crude brown acid* may be used, and in a concentrated form, as it is much more economical ; the other empyreumatic substances accompanying it, appear to add to its value as a disinfectant. It is particularly useful in disinfecting excreta and offensive discharges.

With regard to the uses of carbolic acid as a parasiticide, and in particular diseases, we shall have occasion to notice it again.

It may here be mentioned that its solubility in water is not great, being only about three per cent., a fact worth bearing in mind when prescribing it for external application to the

* The commercial preparations of the acid are : 1 Pure crystals for medical use ; 2 Fluid crystals of the British Pharmacopœia strength for surgical purposes ; 3 Loose crystals for disinfection ; and No. 4 and No. 5 for common purposes. The last-named variety, as prepared by Messrs. Calvert and Co., is guaranteed to contain eighty-five per cent. of carbolic and cresylic acids, free from tar oils and sulphuretted hydrogen ; it is well suited for ordinary disinfection, and may be used in the proportion of half a pint of the acid to two gallons of water. If the odour is objectionable, the purer quality, No. 4, may be employed. Other preparations of it are the "Powder" (carbolate of lime), which should contain at least 15 per cent. of acid, as shown by the neutralization of the lime with hydrochloric acid ; "McDougall's Fluid Carbolate," which is the acid in neutral combination ; "Cliff's Antiseptic Liquid," which is a solution of the acid in soft soap ; "Westerton's Patent Zymotic Fluid," which is a mixture of carbolic and pyroligneous acid and ether, with a little scent ; and there are several kinds of carbolic acid and coal tar soaps. But Letheby, who describes all these, justly recommends that it is best to avoid them, and rely on the action of the pure or nearly pure acid.

body of an animal; it is, however, freely soluble in alcohol, ether, and glycerine. A good test for its purity is the solubility of five parts of it in one part of caustic soda dissolved in ten of water (Letheby).

(8.) *Coal Tar, Wood Tar, Creosote.*

These chiefly owe their disinfectant properties to the carbolic acid they contain. Coal tar is used in infected stables as a fumigant, being slowly heated so as to raise a dense smoke; but it is most frequently employed as a dressing for contaminated walls, wood-work, and iron-work. In addition to its direct action on these, it is still further useful by ozonifying the air, while it impregnates it with disinfecting vapours. Corne has prepared a powder, by mixing three parts of coal tar with one hundred of lime, which, according to Zundel, possesses energetic disinfecting properties, when used in manure and other pits containing organic matter, with animal substances in a state of decomposition, and to fetid gangrenous wounds.

Wood tar is also valuable as a disinfectant and antiseptic; but it is dearer than coal tar, and is no more effective. The same may be said of creosote.

(9.) *Benzoic Acid.*

This appears, from the experiments of Dougall, to be a most powerful antiseptic and disinfectant; greater even than carbolic acid. Its price, however, precludes its use on a large scale. The same may be said of chromic acid and potassium bichromate.

(10.) *Acetic Acid.*

This acts in neutralizing ammonia in putrefaction. Otherwise it is valueless as a disinfecting agent—notwithstanding popular opinion to the contrary. Its odour is, however, refreshing in close stables.

(11.) *Tannic Acid.*

This acid, the active principle of tannin, coagulates albuminoid bodies, arrests fermentation, and is a decided disinfectant.

For a long time it has been known that the process of tanning promptly and certainly destroys contagion. It has even been said that because of the smell of the tan, tanners and their animals are not affected with contagious diseases. Haubner asserts that he only knows of one instance of Cattle-plague invading the cowshed of a tanner, and that by the flesh, not the skins of the animals brought.

Beyond this application of tannic acid or tannin, it is not employed as a disinfectant; though Hager recommended it for the disinfection of potable water (Zundel).

9. *Haloids.*

The most important of these are *Chlorine, Euchlorine, Chloride of Zinc, Chloride of Lime, Chloride of Aluminium, Chloride of Sodium, Chloride of Soda, Iodine, Bromine, Perchloride of Iron.*

(1.) *Chlorine.*

Chlorine is a powerful disinfectant; indeed, it is placed the foremost of these agents, and since the end of the last century has been in general use. It decomposes sulphuretted hydrogen and ammonium sulphide more certainly than any other gas, and is an energetic destroyer of all organic substances prone to decay. It not only checks putridity, and the development of animalcules in organic solutions, but, when only about four per cent. is present, it will kill these. It also rapidly destroys the vitality of vaccine lymph. A proof that it destroys organic matters in the air is its power of bleaching organic pigments. It acts as a deodorizer by abstracting hydrogen, or by indirect oxidization. Its great value as an antiseptic, and a destroyer of miasmata and effluvia, is undoubted and not disputed; but, with regard to its antivirulent properties, there is not the same unanimity; indeed, by some authorities these have been altogether denied. To admit, says Reynal, that the contagious diseases should cede to the action of chlorine—to pretend that it destroys their virus—is to fall into an exaggeration, and to ignore the teachings of practice and experience. In fact, he adds, if we consult the authorities

who have studied contagious diseases, we shall find numerous facts to support this conclusion. Nysten, Vicq d'Azyr, and Grognier, at an early period, disputed the vaunted results obtained with it. The experiments of Jessen, Husson, Verheyen, Reynal, Troillet, Bousquet, and particularly Renault, appear to prove that it does not alter in any way the virus of Cattle-plague, Pleuro-pneumonia, Rabies, Anthrax, Glanders, Sheep-pox, and Vaccinia. Nevertheless, there are the counter-experiments of Labarraque, Weiss, Hertwig, Rueff, and especially of Gerlach, which have yielded results diametrically opposed to those which have been more particularly reported by Renault; and fully confirm the opinion of Guyton de Morveau, Foucroy, Hallé, Chaussier, Desgeuettes, D'Arboval, and numerous others, as to its efficiency as a disinfectant and antivirulent agent. The want of success may have been due to not employing the gas in a dry state, not allowing sufficient time for it to act, or using an insufficient quantity. When freely employed, Zundel, who was for a long time in doubt as to its value, has witnessed its good effects in contagious animal diseases. It is given off in small quantity from chloride of lime, when this is moistened with water or dilute sulphuric acid, or from chloride of soda. It may also be obtained by adding a little muriatic acid gradually to a wine-glassful of Condy's fluid, or to crystals of potassium chlorate.

When larger quantities are required, it may be obtained as follows: To equal parts of common salt and binoxide of manganese (or four parts of the first and one of the second), add two parts water and about the same quantity of strong sulphuric acid, and gently heat. Or to one part powdered binoxide of manganese add four parts by weight of strong hydrochloric acid. Or to three parts bleaching powder add one part of strong sulphuric or acetic acid. Or to two table-spoonsful of common salt and two tea-spoonsful of red lead, add half a wine-glassful of sulphuric acid and a quart of water. The quantities must depend upon the size of the stable to be disinfected.

Generally, the best way to procure the gas is to add the black oxide of manganese to strong muriatic acid, in the

proportion of about a quarter of a pound of the first to half a pound of the second, in a basin, frequently stirring the mixture, and, if possible, heating it.

The chlorine evolved is a heavy gas, its specific gravity being as nearly as possible two and a half times that of atmospheric air. It is extremely irritating to the respiratory organs, and cannot be safely and effectively used in inhabited stables. The buildings which are to be disinfected by it should, therefore, be evacuated; but the harness, utensils, and other implements may advantageously be allowed to remain during the process. The gas should be unsparingly evolved, for in consequence of our not being acquainted with the necessary quantity, there can be no doubt grave mistakes have been committed in not allowing a sufficiency. In serious cases it is well to err on the safe side. The air should be charged with at least one per cent. of the gas.

In consequence of the weight of the gas, the vessel containing the materials for its evolution ought to be placed as high as possible, and so provided that it may continue to give it off for at least three hours. The buildings should be carefully closed, and when the gas has begun to be disengaged no one should enter unless absolutely compelled to do so, when the precaution of placing a damp cloth or sponge before the nostrils ought to be adopted. The place should be kept closed for one or two days, and then well aired.

(2.) *Euchlorine.*

This, the protoxide of chlorine, is a mixture of chlorous acid and free chlorine, and is obtained by gently heating in a saucer, placed in warm water, a mixture of strong hydrochloric acid and potassium chlorate; it has been used instead of pure chlorine. This mode of preparation is sometimes dangerous if a large quantity of chlorate is warmed with hydrochloric acid; it has, therefore, been prepared by placing fuming hydrochloric acid in a wine-glass, and adding a few grains of chlorate from time to time. The odour of this gas is more pleasant than that of chlorine, and this makes it more serviceable in certain cases,

as when animals cannot be moved out of the stable, which must, nevertheless, be disinfected.

(3.) *Chloride of Zinc.*

This is a liquid (usually called Sir William Burnett's fluid) which contains from thirty to fifty-five per cent. of the chloride, and its action as a disinfectant evidently depends on its power of coagulating albumen and absorbing ammonia and sulphuretted hydrogen. Used in the proportion of one part of the chloride to three hundred of water, it instantly destroys infusorial life; and even when diluted so as to contain but one part in 1000 of an organic liquid, it checks decomposition, and prevents the appearance of animalcules and fungi for more than forty days. Its chief use is as a disinfectant of fæcal matters; for it has no power as an aërial disinfectant, and is too corrosive in its action for textile fabrics (Letheby). Diluted with eight or ten times its bulk in water, it may be used to sprinkle floors with, to cleanse mangers, racks, some parts of harness, &c.

(4.) *Chloride of Lime.*

This is a general disinfectant, and acts by virtue of the chlorine it contains, as well as an alkaline substance. A solution of chloride of lime, in the proportion of one pound to two gallons of water, makes a good wash for mangers, racks, woodwork, &c. (after they have been well cleansed); though it cannot altogether be relied upon, the layer being very thin. A more concentrated solution may be employed, and particularly for the disinfection of skins, horns, hoofs, &c.

When it is treated with carbonic or muriatic acid, hypochlorous acid is disengaged; this is an excellent aërial disinfectant.

(5.) *Chloride of Aluminium.*

This, also known as *chloralum,* is a solution containing about fifteen per cent. of the salt, and was at one time supposed to be a powerful antiseptic; but later experiments have shown it to be not very potent in checking putrefactive

decomposition. Its chief use, according to Letheby, is as a precipitating agent for sewage. Not being an aërial disinfectant, it has no influence on contaminated air, and it does not contain anything capable of absorbing miasmata.

(6.) *Chloride of Sodium.*

This is only valuable as an antiseptic and, for the chlorine it contains, a disinfectant. It is useful for disinfecting hides, bones, hoofs, &c., which may be contaminated; it is also a parasiticide.

(7.) *Chloride of Soda.*

Sometimes called Labarraque's liquid, this resembles chloride of lime, but it is not so useful.

(8.) *Iodine.*

This is a substitute for chlorine, though less powerful; besides, it readily condenses, and does not diffuse itself like that gas. It is a good antiseptic, and decomposes sulphuretted hydrogen. It is easily volatilized by placing it on a warm plate; at ordinary temperatures it volatilizes in small quantity, especially if mixed with alcohol or ether. Dr. Richardson has recommended iodine dissolved in amyl hydride (twenty grains to an ounce), but it is too expensive to be largely employed. As an easy and elegant means of disinfection, it might be used in gentlemen's stables.

(9.) *Bromine.*

This is an aërial disinfectant; but a great objection to its employment is its expensiveness and its irritant action on the respiratory organs. A solution of the salt in bromide of potassium is exposed in open dishes to the air.

(10.) *Perchloride of Iron.*

This rapidly arrests putrefaction by coagulating albuminous matters, fixing ammonia, and sulphuretted hydrogen.

10. *Mineral Sulphates.*

The chief of these are *Sulphate of iron, Sulphate of copper, Sulphate of zinc, and Alum.*

(1.) *Sulphate of Iron.*

This may be taken to represent the other metallic sulphates, none of which are volatile, and cannot, therefore, be employed as aërial disinfectants. The more readily decomposed they are the more promptly they act. They are all useful disinfectants when the object is to coagulate albuminous matters and to destroy living organisms, as well as to neutralize offensive miasmata. Each of these substances will prevent the manifestations of infusorial life in organic solutions containing from one to four parts of the salt in the 1000; and a solution composed of from one to two pounds of the substance in a gallon of water is a good disinfectant of drains and fæcal matter. The cheapest is sulphate of iron. In decomposing, it forms, in special cases, oxide of iron, which combines with the other products of decomposition. It is most useful for disinfecting manure and dung-heaps in farms or stables where a virulent disease prevails. The salt should not be mixed with these, but sprinkled over them, so as to cover or envelop them; thus decomposing the gases which are disengaged. Besides this, the sulphuret of iron, into which the salt is converted in disinfecting when it is superficial, becomes again a sulphate by the contact of the atmosphere. It is so cheap that it can be used profusely when required.

(2.) *Sulphate of Copper.*

This is also an antiseptic and disinfectant; but it is too expensive, and is dangerous as a poison.

(3.) *Sulphate of Zinc.*

The same objections apply to sulphate of zinc as to the latter salt.

(4.) *Alum.*

This has similar properties to the preceding salt, and is, in addition, valuable as a purifier of water.

II. *Alkalies.*

These are *Lime*, *Potash*, *Soda*, and *Ammonia*. They are

not very powerful disinfectants unless used in a rather concentrated form, when they are valuable as detergents and for the destruction of organic matter.

(1.) *Lime.*

This is largely employed as a disinfectant, and its utility has been experimentally proved by Solotowski in the disinfection of skins. It is also used to disinfect horns, hoofs, &c. and, as cream of lime, is much used to sprinkle over carcasses &c., as well as to wash the walls of stables, cattle-sheds, slaughter-houses, and so forth. Brought into contact with matters already putrefying, it causes the disengagement of ammonia, which prevents its use except in the case of fresh matter.

When applied in this case, it removes the water and forms a fixed combination with the albumenoids, and induces what has been called "dry putrefaction."

In pieces of small size, it is highly useful to cover carcasses in pits before the earth is thrown over them.

(2.) *Potash and Soda.*

Solutions of these, or their carbonates, are useful as disinfectants, especially when cream of lime is added. Like the lime wash, they are very serviceable for cleansing mangers, racks, and fittings of stables, as well as the walls and floors, which have been previously well scrubbed with hot water. They are also employed to disinfect harness; but as they remove the grease, this must be again supplied. When warm and applied by means of a brush, they are still more effective, and not unfrequently carbolic acid is added.

(3.) *Ammonia.*

This is seldom employed as a disinfectant, and is of little if any value.

12. *Volatile Oils and Aromatic Fumigations.*

From the earliest times, volatile oils, perfumes, and aromatic fumigations have been employed to prevent contagion, and it

is probable that, to a certain extent, they prove useful, as some of them not only check the lower forms of organic life, but also generate ozone. The fumigation with different substances, such as benzoic acid and different kinds of wood, may have been of real utility.

In addition to these substances, there are others which deserve notice. These are the permanganate of potash, charcoal—animal and vegetable—and some other bodies which act as disinfectants.

(1.) *Permanganate of Potash.*

This liquid, known as "Condy's fluid," is an oxidizing agent, and consists of a solution of potassium permanganate. It is a very active destroyer of dead matter, but does not appear, according to Letheby, to exercise much influence on vital manifestations. It is chiefly valuable as an agent for purifying potable water; for it is probable that its disinfecting power has been much over-estimated. Zundel states, however, that it is useful for this purpose, and he recommends a solution of the salt (one to 500 of water) to be thrown into the air of an infected stable by means of a spray-syringe. This solution is certainly odourless—an advantage, no doubt—but it stains everything it comes in contact with. For the disinfection of solid bodies he also recommends it, and particularly as a cleansing and deodorizing agent for the hands after operations, dissections, handling foul wounds, and parturition cases, dressing unhealthy surfaces, and destroying the disagreeable smell accompanying disease of the mouth, ears, &c. He likewise recommends it for washing mangers and other objects soiled by virulent matter, and more especially employs it in Strangles, Glanders, Pleuro-pneumonia, &c., as he considers it capable of not only destroying putrid matters, but also virus and miasmata. With Vogel, he believes that its action is marvellous in this respect, so rapid and certain is it.

(2.) *Charcoal.*

This is a useful oxidizing and deodorizing agent, and owes this property to the power it possesses of condensing upon its

surface, and within its pores, large quantities of vaporous and gaseous matters, which, by the very force of condensation, it brings into contact with atmospheric oxygen, and thus, by a process of slow combustion, burns up organic miasmata almost as thoroughly as if they were passed through the ignited coals of a furnace.

(*a*) *Wood Charcoal.*—This will absorb about nine times its volume of oxygen, and ninety times its volume of ammonia (Letheby). In order to act effectively, there must be sufficient atmospheric air or oxygen, the charcoal must be in sufficient quantity (fine powder or small pieces are best), and if it has been previously used for disinfecting purposes, it should be subjected to a red heat in a close vessel or brazier. It should also be well spread, and kept dry. Of the vegetable charcoals, that of peat is reckoned the best. It is useful for disinfecting the air of closely-inhabited places where certain contagious diseases prevail, for absorbing putrid miasmata, and purifying water. It must be confessed that we have little, if any, evidence to show that it has any destructive action on disease germs.

(*b*) *Animal Charcoal.*—"Animal black," or "animal charcoal," is preferred by some authorities, as superior to vegetable charcoal, and is much used for filtering water. Barthélemy mixed it with lime or plaster to make a disinfecting powder.

(*c*) *Coke*, when newly extinguished and cold, acts like wood charcoal, but more slowly. The charcoal remaining after the distillation of Boghead coal has been stated to be even better than animal charcoal (Parkes).

Charcoal makes valuable air filters for wear over the mouth and nostrils, which may most advantageously be worn in a foul atmosphere.

(3.) *Earth.*

Dried earth is a good disinfectant, especially if it is of a marly nature. A dry, porous soil has a wonderful catalytic action on organic matter.

(4.) *Quick-lime.*

The value of lime has been already referred to. Quick-lime absorbs carbonic acid, and probably compounds of sulphur, and hastens decomposition.*

DISINFECTION.

We have already mentioned the principal bodies which may become carriers of infection, and thus propagate and diffuse contagious diseases. It now remains to describe the manner in which these may be disinfected, commencing with man—who is a very frequent medium of infection—passing on to animals, and afterwards the inanimate bodies that are likely to be tainted.

1. *Mankind.*

People who have been in contact with diseased animals may become the bearers of infection, without themselves being affected in any way. "Cattle-plague," "foot-and-mouth disease," and other maladies are markedly conveyed by human intervention; and, indeed, it has been only too frequently observed that man is a most dangerous agent in the transmission of certain contagia.

We have described the different substances and articles which more readily carry infection, and among these it was noted that woollen and cotton stuffs appeared to receive and preserve it with the greatest facility. These usually form the clothing worn by persons who go among animals; but the shoes, from their likelihood of becoming soiled by excre-

* It may be well to mention that Dougall has proved experimentally that the following substances are most potent agents in destroying the lower forms of animal life :—sulphate of copper, chloride of aluminium, chromic acid and bichromate of potassium, bichloride of mercury, benzoic acid, bromal hydrate, chloral hydrate, hydrocyanic acid, alum, hydrochlorate of strychnia, ferrous sulphate, arsenious acid, and picric acid. O'Niel found bichromate of potash to be the most powerful agent in preventing the appearance of Bacteria; and next, but much inferior to it, carbolic acid. Bisulphite of sodium and permanganate of potassium had no influence on their development.

mentitious matters, which in some diseases are highly impregnated with virus, may be as potent in conveying contagia.

The disinfection of persons who have been in contact with diseased or contaminated animals is, therefore, a most essential measure in the prevention or suppression of contagious maladies, and should not be neglected; more particularly if these persons are likely to go among healthy creatures capable of receiving the infection. Indeed, in nearly every instance, disinfection may be limited to these. The custom of fumigating every traveller that arrives from an infected country, as is sometimes done on the Continent, is not only a useless measure, but is troublesome and vexatious in the extreme. It is the same with the procedure, carried out in Germany, of placing persons to be disinfected in a box, where they are subjected to fumigation by chlorine or sulphur; as, in the first place, incompetent persons usually have charge of this measure, and, in the second place, we have no proof that chlorine, and especially the very feeble quantity disengaged during the process of fumigation, can have any destructive effect upon a virus concealed in a person's clothes. This measure is also liable to be greatly abused.

In general, disinfection of the clothes—more particularly of those which are outermost—of contaminated individuals, with carbolic acid solution will be sufficient; the hands should be washed in the same, as well as the boots; but when the contagion is very subtle and tenacious, this cannot be relied upon to prevent the disease extending. It is therefore better to compel the veterinary surgeon, and those who attend to the diseased animals, to remain within the limits prescribed by the sanitary regulations—within, in fact, the sanitary cordon which has been traced around the infected place. And to secure as far as possible the localization of the contagium, all strangers, cattle-dealers, butchers, and others likely to go among the infected, must be peremptorily excluded; while those who must attend to the sick or suspected animals should be prevented from going beyond the limits of isolation until all danger has been dissipated by the complete recovery or death of the diseased, and apprehensions with regard to the

suspected have ceased. Then a thorough cleansing and disinfection of the clothes may be undertaken immediately; to do this earlier would be almost useless.

2. *Animals.*

Animals belonging to other species than those diseased, often serve as bearers of contagia from one place to another; for instance, in Cattle-plague, dogs, horses, pigs, sheep, foxes, and birds have been known to spread the disease.

Disinfection is most difficult of application in the case of such animals, and can scarcely be carried out so efficiently as to preclude risk. Washing the surface of the body of those creatures which have been in contact with the diseased or suspected with disinfecting agents—as carbolic acid—or submitting them to fumigations, is often an onerous measure, and not always practicable when the infection centres are numerous and extensive. Nevertheless, it should be attempted when circumstances will admit of it; but it is generally more advisable to confine as many as possible of the domesticated animals in an infected locality within the sanitary cordon until the disease has been extinguished. Dogs should be tied up, fowls enclosed, and the movement of cattle and sheep beyond their own sheds or pastures prohibited.

3. *Carcasses and Animal Products.*

The interment of the carcasses of animals which have perished from, or been killed in consequence of being affected with, a contagious disease, and after the skin has been slashed, is a most certain method of getting rid of infection in serious cases, when it is deemed unadvisable to utilize either the flesh or hide. When there is danger of the carcasses being disinterred, their saturation with different substances which may render the flesh unpleasant and useless, has often been practised. Lime is also frequently employed in covering these carcasses, to expedite decomposition and destroy infection; and in sandy soils it is doubtless efficacious, but in those of an argillaceous character it has not nearly the same value. The destruction of carcasses by fire is generally expensive

and inconvenient, and seldom resorted to. In the majority of cases in which these diseases prevail in localities where knackers' establishments exist and are properly conducted, the carcasses may be utilized, provided every care is taken to prevent the dissemination of the contagion.

Skins.—The *preservation of the skins* of several of the domesticated species is, at any rate, often a most important object, because of their value, and the facility with which they may be disinfected. If it is not possible to submit them at once to the operation of tanning without risk, they may be exposed to sunlight and a current of air until quite dried, in a place where men or animals cannot come in contact with them. According to Renault, this drying requires from fifteen to twenty days, and the skin should lose two-thirds of its weight. In winter, such a desiccation is not possible in some climates; and it will be seen, when we come to speak of the contagium of certain diseases, that a freezing temperature does not afford any guarantee against contagion. Drying by means of heated air has, therefore, been recommended; and this is quite practicable in a shed, using straw or brushwood as fuel. Jessen and Solotowsky have proved that the skin of an animal which was affected with Cattle-plague, when exposed for forty-eight hours to a temperature of 50° Centig. (122° Fahr.), or during four days to 36° (96·8° Fahr.), loses its contagious properties.

"Salting," or "pickling," is usually resorted to for the preservation and disinfection of skins; and, according to Contamine, when this salting has been thoroughly carried out, it is equivalent to desiccation, and only then may be considered as equal to disinfection. The skin should be very hard, and resonant when struck, the salt being visible in crystals on its inner surface, and no reddish exudation should have been seen on it for some time. Insufficient salting will not destroy infection; it is generally necessary that the hides be spread out in layers in a convenient place, and that each absorbs from eleven to thirteen pounds of salt, remaining in it for at least a month before they are allowed in the market.

It has also been recommended to place skins for twenty-

four hours in a solution of chlorinated or carbolated chalk or lime, and afterwards to expose them to the air for at least eight days. This system of disinfection has been prescribed in Austria and adopted in Bavaria. According to Solotowsky, steeping a skin for forty-eight hours in milk of lime will destroy the contagium of Cattle-plague; but that with a wash of wood-ashes, this result is not obtained.

It has been suggested that such skins should be submitted to the fumes of chlorine, sulphurous acid, and external dressings with a solution of carbolic acid; this, however, requires special buildings, and is expensive.

Tanning is the quickest, most certain, and most economical procedure, having in view the results obtained, and when it can be resorted to without danger should always be counselled.

Flesh.—The disinfection of flesh is difficult, and seldom profitable. In some maladies, when it is perfectly cold it is harmless; though in others, as in the Cattle-plague and Anthrax, as well as in some parasitic maladies, it is not so. Thorough cooking, salting, or smoking generally renders it innocuous, so far as infection is concerned. There is, in the majority of cases, less danger of contagion in allowing flesh to be carried about and sold, than permitting the animals to move in districts or localities.

Fresh tallow.—Tallow stands in the same category as flesh, but thorough melting at a high temperature will certainly destroy its infectious properties. For this reason, the carcasses or tallow of certain animals may be utilized in the manufacture of soap or candles. In some countries the rumen has been used to contain the tallow, but this is not judicious, and should not be allowed.

Viscera.—If the viscera are permitted to be utilized, they should be well dried or salted. As a rule, however, in many diseases it is advisable to destroy these, even when the skin and flesh are utilized.

Bones.—Bones after being boiled for an hour at least, and then dried in the air, should be safe. The superficial carbonization prescribed in the Austrian regulations may be also adopted,

or they may be treated with a solution of carbolic acid (one to 100). Old bones are generally harmless.

Horns and hoofs.—These, when well dried or treated as above, are disinfected. Even when well dried and salted they should be free from infection.

Wool, bristles, and hair.—These should be exposed to the air, and be well dried for at least six or eight days, before they are pronounced free from infection.

Excrements and manure.—The *excreta* of certain diseased animals are extremely virulent, and are a frequent cause of extension of a contagious malady. Fresh excrements are, as a rule, much more dangerous than those which are putrefying, though the latter may also be sufficiently dangerous to require attention. It is frequently recommended to burn the *excreta;* but unless they are well mixed with straw, this is scarcely possible. Zundel suggests that while they are yet lying in the stable or shed they should be sprinkled with crude carbolic acid, about two pounds to twelve square feet, after which the same proportion of chloride of lime must be used. Or such metallic salts as sulphate of iron, or chloride of zinc (of the specific gravity of about 1·100), may be employed. As it is necessary to disinfect the stable as well, this is hermetically closed for two days, after having been well fumigated with chlorine. The fæces are then removed to a trench sufficiently deep, and covered with a layer of earth three feet thick. It may, if worth the trouble, be used as manure on the land after about a year.

The dung lying in the courtyards, unless it has been mixed with fresh fæces, should be differently treated. It ought to be sprinkled with sulphate of iron in fine crystals or powder, as well as with crude carbolic acid; then it should be moderately watered to drive these substances into the body of the manure. Afterwards it should be carried away in a cart to a spot sufficiently distant from any highway, and at once ploughed into the ground. The precaution must be observed, however, of not employing animals which are susceptible of the disease, and all manure that falls by the way should be carefully gathered up. It has been sometimes recommended

to gather the manure in heaps, and merely mix it with absorbent materials: earth, dried peat, sand, lime, or chalk, or more complicated compounds of plaster and coal-tar. But in order to do this much labour is required, and there is, after all, less certainty.

The urine and drainage cannot be so readily disinfected and carried away as the fæces. It is best to leave it in the drains or pits, and apply sulphuric acid to it—about half a gallon to every twenty-two imperial gallons; the ebullition and heat evolved must destroy the virus, if there is any.

For dung-heaps, if these are remote from fields, lanes, highways, and other places frequented by susceptible animals, thorough putrefaction is the best destroyer of virus, especially if it occurs with free access of air.

4. *Straw and Fodder.*

Infection is often conveyed by these; and not only when they have been in actual contact with diseased animals in stables or sheds, but when they have been in lofts above these, and have thus absorbed their exhalations. This has been observed in such diseases as Cattle-plague, Pleuro-pneumonia, Foot-and-mouth disease, Anthrax, &c., and it has also been proved that these substances may preserve the virus for a long, but variable period—longer indeed than it can otherwise be preserved. We shall give instances of this hereafter, and have only now to observe that this renders their disinfection a matter of great importance, though, for certain reasons, this measure is almost impossible.

In those cases in which the disease is not serious, or the virus is not very tenacious, merely exposing straw and forage to the sun and air for from eight to fifteen days, and turning them over frequently, will be found sufficient to disinfect them. In other maladies, however, as in Cattle-plague, Pleuro-pneumonia, &c., they must either be given to animals which are not liable to these diseases, exercising all proper precautions; or they must be burned, compensation for the full value of the property being allowed to the owner.

5. *Habitations.*

In all contagious maladies, disinfection of the buildings sick animals have occupied, even though they have not been tenanted for a certain time, must be practised. The history of these diseases, and every-day experience, demonstrate the necessity for this measure. At the same time, judgment is required in this matter; as when the disinfection is imperfectly carried out, there may remain as much danger as there may be needless expense and trouble when it is carried to excess.

This measure most frequently fails through its being left to the owner or occupant of the place to carry out. Such an important sanitary precaution, which is generally of public utility, and not alone for the benefit of the proprietor, should be undertaken at the public expense, and superintended by the district veterinary surgeon. The owner should, at any rate, be compensated for any loss this measure may cause him; always provided that the introduction of the contagion was not due to his own carelessness, and the existence of the disease was not concealed after it became apparent to him.

In such serious affections as the Cattle-plague, Pleuro-pneumonia, and Foot-and-mouth disease, the disinfection cannot be too thorough and extensive, the contagion being "volatile;" but in those in which it is "fixed," as in Glanders, Mange, &c., this measure might be limited to only those parts which may have been contaminated through contact with the diseased—such as the wood-work of the stables, which, being porous, may preserve the virus for a long time, and which it may even be necessary to destroy in many cases. As soon as the general disinfection of the infected stable has been carried out, with a view to purify the atmosphere in it, and the litter and manure has been treated and carried away in the manner already recommended, all the movable wood-work should be taken down, conveyed to a convenient place, and, after having been valued by an expert, burned.

In other cases, however, if it is deemed possible to thoroughly disinfect this wood-work, it may be allowed to remain, and there be cleansed. This should be done by means of hard

brushes and hot alkaline washes, and previous scraping or rasping may even be necessary. The wash recommended by Zundel, who has paid great attention to this subject, is that obtained by dissolving soda in boiling water, and adding lime: a caustic soda being thus formed which is very destructive to all parasites and organic matter, and requires care on the part of those who employ it, as it is very irritating to the skin. Sometimes carbolic acid is added to this wash.

Wood-work fixed in the ground or walls is more difficult to disinfect than mangers, racks, walls, &c. It should also be well cleansed and washed with the caustic mixture, and then dressed with gas tar. In some cases it may be necessary to destroy it.

If the walls are of plaster, this should be removed to a certain depth and replaced by new cement. The removal of the old material is best effected before the manure is removed from the stable, as it may be carried away and buried with the latter. If they are built with stone or brick, the surface of this should be scraped and washed with soda, particularly in corners and crevices, and be followed by a coating of very thin gas tar or quicklime. If the roof is not to be destroyed, it must be treated in the same way; the whole being lime-washed after disinfection, if the proprietor wishes to have this done at his own expense.

The doors and windows should be considered as fixed wood-work, and well washed with the caustic dressing. If the utensils are of little value they may be burned; in other instances they may be washed. Iron objects, when removable, should be passed through the fire; when fixed, they may be treated like the other parts.

Lime washes, and among them that of the chloride of lime, should not be relied upon solely as disinfectants, as their action is very superficial. They may be used after the other washes, however. The same may be said with regard to weak solutions of carbolic acid.

The floor of infected stables requires special care. If it is of asphalte, brick, or cement, it need not be raised, as it is almost impermeable; a simple washing with caustic solution

or brushing well with boiling water, is generally sufficient. With a stone floor the case is different, as the soil between the stones may become a receptable for infectious matters, especially if the sick animal has been some time in the stable. In such circumstances it is advisable to take up the stones, wash them with quick lime, and remove the soil to a certain depth, replacing it by fresh earth. If the floor is of wood, it is generally the most economical course to destroy it; when this is not done, it should be well soaked with the caustic wash, and afterwards covered with thin coal tar. It may be necessary to take up the floor and change the soil. This removal of the soil is especially indicated when it is of a clayey or sandy nature. The superficial layer should be carried away with the manure and interred with it, and on the new surface a layer of small pieces of quicklime should be laid on before the new soil is applied; the latter ought to be well rammed down.

It is generally the best course to pull down and burn stables or sheds built of materials which cannot be disinfected, such as hurdles, heath, straw, &c.

6. *Aërial Disinfection.*

Aërial, or general disinfection—by which we mean the purification of the air from infectious matter—is necessary in epizoötic and contagious diseases, when sick animals inhabit, or have inhabited, sheds or stables. It is a most important measure, as the atmosphere is readily contaminated by a volatile virus, miasma, or deleterious effluvium, and may carry these to a considerable distance by winds and currents.

A good current will often assist in preventing the contamination of the air in cases of putrid infection; trees may hinder the circulation of malaria in a marshy country; but infecting agents are not thus destroyed. Frequently it is only necessary to remove the moisture from the air by quicklime or chloride of calcium, to prevent its being infectious; and in this way miasmata and contagia may be neutralized; but these means are not always successful; indeed, they cannot always be applied with any chance of success. In the case of a

volatile virus, powerful chemical agents are necessary, and even these do not always succeed. We have already described these agents and the manner of using them.

It may only be necessary to mention that Zundel recommends, as an excellent method of disinfection of a building inhabited by animals, the employment of a solution of permanganate of potash in a sufficiently wide vase, so as to afford an extensive contact with the air; and if the brown stains made by this fluid are not objected to, it may be sprinkled over the floor and walls, and even thrown into the air as spray by a suitable syringe. Carbolic acid, because of its non-irritant properties, may also be employed in such a case. Charcoal has also been recommended in those instances in which animals cannot be moved from their dwellings, but its action is not to be entirely depended upon. Chlorine, chloride of lime, acetic acid, &c., have all been used as aërial disinfectants. Coal tar has also been burnt in small quantities in stables; and the slow combustion of wood, especially that of the pine, has been at times resorted to for the destruction of aërial infection.

Whatever plan is adopted, the fumigation, if possible, should be thorough in the case of serious diseases, and the greatest care should be exercised to ensure the diffusion of the disinfecting gas everywhere in the stable or shed. For empty habitations, perhaps the fumes of chlorine, nitrous acid, or sulphurous acid, are to be preferred as the most economical and certain. The latter is recommended by some authorities. The sulphur should be placed on a metal dish, some alcohol poured over it, and lighted, every outlet having been previously closed. Parkes gives the proportion of sulphur as one pound for every thousand cubic feet of space, and if the building be long, to burn this substance in several places.

After a thorough disinfection, the doors and windows of the stables should be thrown open for a number of days, for the free admission of air and light.

7. *Harness and Equipment.*

The most certain means of disinfecting harness, clothing,

&c., of sick animals, as well as the clothes of those who have been in contact with them, is to expose them for a certain time (from six to twelve hours) to the action of hot air in a stove or oven—a temperature of from 212° to 250° being sufficient, or even lower, if there is danger of destroying the articles.

Objects of little value are generally not worth the trouble and risk, and may be burned.

Harness should be taken to pieces, all the iron work removed and passed through the fire, and the leather steeped in and scoured with soda wash (not too strong), then sponged with carbolic acid solution, and before dry well greased. Polished leather may be merely washed with soap and water, and dressed with the carbolic acid solution. Head-collar chains and other iron articles should be heated in the fire.

Clothing, woollen and other stuffs, must be disinfected according to their nature, the tenacity of the virus, and perhaps also their colour. Woollen articles should be treated with boiling water and soap, or carbolic acid; and those of cotton or flax may be steeped in caustic wash, and well scoured and dried.

If convenient, and deemed necessary, these articles may be further subjected to the action of disinfecting gases, should the loss of colour be no objection.

8. *Railway Waggons.*

Railway waggons should at all times be kept as clean and sweet as possible; but during the prevalence of a contagious malady, or when they carry animals from infected or suspected countries or localities, they should, in addition, be scrupulously disinfected, and the manner in which this disinfection is to be carried out should be laid down by Government regulation, so as to secure uniformity and certainty of action. There can be no doubt whatever, that railway waggons and trucks have been, and are now, active agents in disseminating contagious diseases. From the traffic which has been, and is now being, carried on in these, as well as the imperfect disinfection and cleansing they receive, no other result could be anticipated.

This disinfection should be done by and at the expense of the railway companies on ordinary occasions; but in such ex-

ceptional cases as when the owner of diseased animals, on the recommendation of a veterinary surgeon, sends these by rail to a slaughter-house of some town, or when he knowingly allows infected cattle to travel in this way against the regulations in force, he should pay for the disinfection of the trucks.

The disinfection of railway waggons and trucks should be simple, economical, cheap, and effective. The Austrian regulations prescribe washing with boiling water, then with lime wash, and afterwards well airing. Gerlach proposed to substitute douches of steam, which could be applied at a higher temperature than that of boiling water, and could be supplied from a stationary engine, or even from a locomotive. The proposition is a good one, and the expense of carrying it into operation would be trifling; while the time necessary for disinfecting a waggon or truck would be less than that required for any other method. The boiling water or steam should be supplemented by brushing and washing, either with lime wash, permanganate of potash, or other powerful disinfecting agent. The floors of these carriages should be particularly attended to in the matter of cleansing and disinfection.

9. *Cattle Ships.*

Cattle ships have been, and generally are even now, potent instruments in infecting healthy animals, and maintaining and disseminating contagious diseases. Only too frequently badly constructed for the purposes of animal traffic, the amount of cruelty and damage inflicted in them is sometimes quite appalling; while from the absence of anything like supervision, a desire to keep them free from infection, as well as owing to their construction, they are seldom, if ever, properly cleansed and disinfected.

The first object is, of course, to have properly constructed cattle-ships; the next is to establish regulations with regard to cleansing and disinfection, and make certain that they are carried out.

The measures of disinfection should be similar to those recommended for railway waggons. Douches of steam from the ship's engines—superheated if need be—and carefully applied

to every part of the deck, hold, or other place which is allotted to animals, with subsequent lime-washings, and the free use of permanganate of potash, salts of iron, or other inodorous disinfectants, ought to be resorted to, and supplemented by cleanliness and free ventilation.

10. *Slaughter-Houses, Cattle-lairs, Knackers' Yards, &c.*

These places should be cleansed, and, if necessary, disinfected under the supervision or inspection of the local or district Government veterinary surgeon. Cleanliness should be rigidly maintained, and this, together with the expense of disinfection, should be at the expense and care of the proprietors. Frequent washing and flushing with water, thorough ventilation, disinfecting with chloride of zinc, permanganate of potash, &c., and dressings of chloride of lime and cream of lime should not be neglected.

11. *Water-troughs.*

It is to be feared that the public watering-troughs, instituted with the most praiseworthy motives, are sometimes the source of infection after being contaminated by diseased animals; and it is not at all improbable that the equine disorder, "glanders," has been propagated in this way, especially as the sanitary regulations for suppressing the disease have, for want of an organization to carry them out, been all but a dead letter.

These troughs should be frequently emptied and cleansed, and the materials of which they are composed well dressed over with some powerful disinfecting agent. The necessity for emptying them often is apparent from the fact that, in the act of drinking, discharges from an animal's nostrils are most likely to flow into the water, which, if it be a horse suffering from Glanders, will thus become contaminated and may infect others; for it has been experimentally demonstrated that the disease can be produced through the digestive organs.

12. *Water.*

Water which is infected, or suspected of containing infection, should be carefully disposed of, as it is generally not worth

the expense of disinfection. Should the latter measure, however, be resolved on, boiling the water for a short time, and then filtering it through charcoal, will render it safe. Or a sufficient quantity of permanganate of potash solution (added until a pink tint is produced and maintained), allowed to act on the water for a few hours, is tolerably safe ; chlorozone has also been recommended with the same object, and in the same way.

DUTIES AND RESPONSIBILITIES OF AUTHORITIES.

The municipal and county authorities should constitute, collectively, an unceasingly vigilant guardianship over the interests of the community ; and viewing their important functions in this light, one of their duties, and on occasions one of great moment, is that of protecting it from the ravages of contagious diseases. When a scourge of this kind appears in a country, their duty is to act decisively, and adopt all necessary sanitary measures to prevent its invading their own localities ; or, if it has already done so, to limit or arrest its course, and diminish its ravages to the smallest possible dimensions. Their responsibilities are, therefore, great in proportion as a disease of this kind is destructive and dangerous ; and while the central government authority should take every care that the law is uniformly applied with regard to sanitary measures, so as to obviate the discreditable, vexatious, and injurious results that must accrue from disjointed action—extreme rigour in one county, the grossest carelessness and laxity in another ; yet a certain amount of latitude must be allowed to meet the exigencies of particular cases and emergencies. But this latitude imposes on the local authorities responsibilities which may become very heavy at times. When officially informed of the existence, or the apprehended invasion, of a contagious malady, their duties are two-fold ; those of a general kind and in the interests of the community, and those of a particular character, and having special reference to the interests of individuals—the owners of animals. We have already referred to the general measures, and, except in the most urgent cases, the authorities should not resort to them,

not even temporarily, without first referring to the central authority.

The particular measures relating to individuals who own animals affected with, or which are suspected of a contagious disease—such as declaration and isolation—should, however, be left with them, to enforce on their own responsibility; as they may demand prompt application in order to limit the malady before the central authority has had time to be communicated with.

The local authorities should also have powers conferred on them to carry out the laws with regard to measures of public health, and likewise to devise measures (with the sanction of the central authority) for the inspection of slaughter-houses, knackers' establishments, cowsheds, and stables, and more particularly the flesh and milk which are to be consumed as food.

We will again notice the action of the authorities with regard to the suppression of contagious maladies; but it must here be insisted upon, that their functions are mainly to carry out the sanitary laws with regard to these, and in doing so motives of self, or even local, interest should not be allowed to interfere with what is a most important public duty. The interests of individuals must be made subordinate to that of the general welfare; and in proportion as the authorities act disinterestedly, promptly, and energetically, and follow closely the counsel of those who are in a position and competent to inform them, the less danger is there to be apprehended from the presence of contagious diseases. Lax, lukewarm, or disjointed action means simply public and individual loss, embarrassment, fraud of every kind, and contagious diseases becoming domiciled, extended, and a perpetual scourge.

DUTIES AND RESPONSIBILITIES OF OWNERS OF ANIMALS.

We have already pointed out the large interest owners of animals collectively have in the prevention or suppression of contagious maladies, and have also indicated the importance of the necessary measures, and how materially the proprietors can aid in carrying them out to a rapid and successful issue. Among these, the foremost is declaring or reporting the appearance of a contagious or suspicious malady; this duty—for it is

a duty, and its neglect should be severely punished—is of paramount importance, and in order to guard against mistakes and their consequences, this declaration should be in writing, the authority who receives it giving a voucher for its receipt. Immediately following the declaration, or at the time of discovery, the sick or suspected animals should be isolated : the necessity for this is apparent.

When the authorities have taken the matter in hand, the proprietors are bound to afford them every facility and information necessary for discovering the origin of the outbreak and arresting its course ; there can be no greater offence against sanitary laws than concealing the existence of a contagious malady, and disposing of the sick or contaminated clandestinely. Everything connected with the general measures more or less affects owners, and their interest and hearty co-operation in carrying them out is an essential element of success.

DUTIES AND RESPONSIBILITIES OF THE PUBLIC.

By the term "public" may be included all those who have a more or less direct interest in the suppression of contagious diseases among the domesticated animals ; and there are but few who have not an interest in one way or another, and still fewer who cannot aid to some extent in carrying out the laws when a wide-spread malady prevails. In the common interest, butchers, cattle-dealers, knackers, proprietors, grooms, herdsmen, shepherds, and others, should see that no infraction of the sanitary law takes place, and that they are carried out in a proper manner. When a government obtains the assistance of the public with this object, the extinction of spreading maladies cannot be doubtful.

DUTIES AND RESPONSIBILITIES OF VETERINARY SURGEONS.

The veterinary surgeon, during the existence of contagious diseases, has most important duties to fulfil, and the responsibility that rests upon him may be said to be greater than upon any of those who have to officiate at this crisis. The duties incumbent upon him are those towards himself, his profession, his colleagues, the law, and the authorities.

1. *Duties towards Himself.*

The veterinary surgeon owes it to himself to study carefully these contagious diseases, to point out their dangers, and to indicate the best means for suppressing or arresting their progress. During an epizoöty, it is the duty of everyone, and more particularly of the veterinary surgeons, to bring every available resource to bear in combating it. This intervention on the part of the latter constitutes their share of social responsibility during the reign of these great public calamities. True, the veterinarian, as Reynal justly remarks, will not receive the applause and acknowledgments of the physician, whose devotion and self-denial increase with the toil and danger that is incurred during an epidemy among his own species ; but the part the former plays, if more modest, is not the less meritorious. In lending his concurrence to the execution of the common task, the great and final aim of which is the welfare of the entire community, he is sure to find in the appreciation and sympathies of his co-citizens, that ample recompense which moves men to strive for the good of their fellow-creatures. The veterinary surgeon has not only the dictates of humanity to guide him—and which the physician alone has—but he has, in addition, those springing from the importance of his task in a monetary point of view. The national fortune, so far as animals are concerned, is more or less at stake, and also the comforts—nay, the very necessities of life—of large numbers of people may depend upon his exertions; the health of mankind may even be endangered by the outbreak of an animal plague.

Zeal, self-denial, scientific skill, and all those high qualities which the votaries of medicine have so frequently displayed during the reign of a deadly disease, the veterinary surgeon may manifest equally with the physician. It is, therefore, a duty he owes to himself, to cultivate his intelligence and to maintain those moral qualities which can alone enable him to exercise his professional qualifications with advantage to himself and to others.

2. *Duties towards his Profession.*

The duties of the veterinary surgeon towards his profession are pretty well summed up in those towards himself. Its value and status entirely depend upon the intelligence, zeal, and proper conduct of its members. When a man exercises a profession which gives him an honourable position in society, and to which he owes his means of subsistence, it becomes an imperative duty, as it should likewise be a grateful acknowledgment of these benefits, to devote himself entirely to its advancement in every legitimate way, and to demonstrate its importance and utility. And at no other period, perhaps, can this be so well shown as in the matter of contagious diseases; the veterinary surgeon is, in the controlling of these, in a position to testify to its utility and importance to agriculture and the public in general.

3. *Duties towards his Colleagues.*

It would appear to be scarcely necessary to do more, in referring to this duty, than to assert that members of such a profession as that of veterinary medicine should be actuated by the highest principles of equity towards each other. All are bound, by the closest ties, to forward the interests of their common profession, upon which they are all dependent. They should, therefore, be ready to assist each other; their unanimity, mutual respect, and confidence are indispensable in so far as the public interests are concerned, and they are necessary in maintaining the honour of their profession. Concord, and an absence of unworthy rivalry and dissension, is required at all times, but particularly when destructive diseases prevail. It is the duty of the veterinary surgeon, besides, to consult with his colleagues in times of difficulty and doubt; to communicate to them the results of his observations and labours; to discuss with them, when necessary, important questions; to enable them to profit from his researches, as he should profit from theirs; and, if need be, to publish these for the benefit of the places invaded or threatened by a contagious disease. In this way, the members of the veterinary profession may

afford most valuable aid in the localities where the malady prevails, and the administration may be furnished with facts which will enable it to devise more effective sanitary measures.

4. *Duties towards the Law.*

The duties of the veterinary surgeon towards the law, are no less to be scrupulously observed. He should not be permitted to treat any animal affected with a serious contagious disease until he has reported its existence to the authorities, or has caused the owner to do so; and any infraction of the law he should be ready to give information of. The share in those measures for the suppression of a contagious disease which he may be called upon to undertake, ought to be strictly and conscientiously carried out, and with sufficient zeal to ensure the best results.

5. *Duties towards the Authorities.*

As has been already so frequently mentioned, when a contagious disease appears in, or threatens to invade, a locality, the authorities should take every possible precaution, and in order to do this must seek the aid of science. When the outbreak is serious, and the malady spreads rapidly, involving a large number of animals, the central authorities should intervene, and delegate one or more of their best veterinary inspectors to study the disease, its nature, the manner of its propagation, and prescribe the measures necessary for its suppression. When the malady is less serious, the local authorities might entrust this duty to the district inspector, who may be accompanied by a municipal delegate.

In the performance of such a duty, the veterinary surgeon is bound by every sentiment of honour and justice to devote himself entirely to his mission, which is one of great importance. According to the nature of the outbreak, he will more or less promptly report to the authorities who have sent him its chief characteristics, its gravity, and the best means of preventing its extension. In his communications with the owners of animals, however, he must maintain a judicious reserve; and if he prescribes medical treatment or private hygiènic mea-

sures with regard to suspected or sick animals, he must also remember that he cannot recommend and enforce sanitary measures; to the administration alone belongs the power to render these obligatory. Those which the veterinary surgeon may think it necessary to suggest, and, with the owner's consent, to carry into practice, are but provisional until sanctioned by the authorities. The veterinary surgeon is charged by these with the duty of carrying the general measures already described into execution in healthy or infected localities; and in order to accomplish his oftentimes delicate task satisfactorily, he should maintain a firm attitude against all interested solicitations and influences: acting with circumspection, guided by his conscience, and never departing from that spirit of deference and conciliation which is so essential in an agent entrusted with such a mission.

In his relations with the authorities, the same influences should govern him. His recommendations and suggestions to them should be conceived in a practical spirit, couched in the clearest terms, and devoid of all scientific technicalities which may mislead. Representations as to the necessity for certain measures should be well founded, and the urgency for their adoption brought prominently forward; if they are disregarded, the injurious consequences which may result ought to be pointed out, so as not only to protect himself from blame, but also to warn the authorities of the danger of their supineness or neglect.

GENERAL PROCEDURE IN SUPPRESSING A CONTAGIOUS DISEASE.

In order to indicate how the general measures should be carried out with such a sanitary service as has been suggested, it may be useful to suppose the outbreak of a contagious malady, and trace the steps that might be adopted in extinguishing it, more especially with reference to the duties of the veterinary inspector.

1. *Outbreak of a Contagious Disease.*

If in a stable or locality, and within a few days, a number of

animals become unwell, the non-professional representative of the local authority should report the same to the county authority; and, provided no declaration has been made as to the existence of a contagious disease, if the number increases, he should cause all the animals belonging to the same proprietor to be kept apart from those of others, and attended to by particular individuals. Pending the arrival of instructions from the county or district authorities, this functionary may endeavour to obtain information as to the nature of the disease through any competent person within reach, and to adopt such medical treatment and sanitary precautions as may be deemed necessary for the moment. If he cannot command the assistance of a trustworthy veterinary surgeon, he must at least attend to the isolation of the supposed infected places, until the superior authorities have considered what steps are necessary.

On the announcement of the appearance of a contagious disease, the district authority sends into the locality the veterinary inspector, and, if possible, an official representative of the authorities in addition. Their duty should be to investigate the facts relative to the outbreak, and to devise whatever measures may be considered necessary with regard to medical treatment and sanitary requirements. A special report of this visit and these measures should be made.

If, in consequence of the distance being too great between the infected place and the residence of the veterinary inspector, it is not possible for the latter to undertake the entire management of the outbreak, or if this is not required in consequence of the trifling importance of the disease, its subsequent management may be confided to a local veterinary surgeon, who should be furnished with oral, or, which is better, written instructions as to every detail in the course he is to pursue. The veterinary inspector and the other official should visit the locality, if necessary, at certain periods—say every week or fortnight, according to circumstances—to see that the instructions are properly carried out, until the disease is finally subdued, and at each visit a report ought to be made as to the state of affairs.

Administration.

If in a country an epizoöty has become greatly extended, the region should be divided into a certain number of "districts," if this has not been already done, as suggested when speaking of a veterinary sanitary service, so that each may the more readily be inspected. For each district there should be a delegate of the administration, a veterinary inspector, and a police official (in Austria, and on the continent generally, it is usually an officer of the army or gendarmerie), who will constitute the district commission, and see that the sanitary measures are rigorously carried out. This commission should be located as near as possible to the centre of the district, so as to be able to extend its observation to the different localities. It should work in co-operation with the local authorities, or, when differences with these arise, it should receive special orders from the central authority, and the power so conferred ought to enable it, in cases of emergency, to take strong measures when its injunctions are neglected or evaded.* The veterinary inspector should be held responsible for the measures he recommends; the administrative delegate, as well as the head of the district administration, being responsible for their prompt and effective execution.

If the disease is widespread and virulent, the veterinary surgeon should continue to forward his reports to the district administration, which again will transmit a copy to the county administration; or they may be forwarded direct to the county authorities, and be by them transmitted to the central administration.

* In Austria, where the measures against contagious diseases in animals are excellent, a commission of this description is not only authorized to demand the assistance of the troops as often as may be necessary, but can also punish with arrest or pecuniary penalty—three days' imprisonment and fifty florins fine—those who conceal the existence of the disease, or who have not scrupulously carried out the prescribed measures. The only condition on which these powers are conferred is that of drawing up and forwarding a *procès-verbal* to the authority from whom they received their instructions.

Reports.

The reports furnished by the veterinary inspector may be enumerated as follows: The first report, containing a statement or abstract of the facts obtained on the first visit; then periodical reports; and the final report. In order that the authorities, by these reports, may have sufficient information as to the origin, nature, and extension of the outbreak, so as to authorize the necessary measures, or in doubtful cases, perhaps, to take the opinion and advice of other competent persons, these reports should be fully and clearly drawn up. In doing this the following outline may serve as a guide :—

FIRST REPORT.

Abstract of Facts.

This is contained in this report, which is sent in at the commencement of the outbreak. These facts should include everything relating to the morbid symptoms, pathological anatomy, and course of the disease: its origin and mode of propagation—all, in fact, that may serve to establish its character. This report should be very carefully drawn up, as upon the exactness of the diagnosis, and the just appreciation of the occasional causes, will depend the nature of the measures and the general line of procedure to be adopted. It should there run somewhat as follows :—

(*a*). The place and date; a suitable "heading," and a "synoptical table" of the state of the disease.

The *heading* comprises the name of the village, district, or locality in which the disease exists, the date of the report, the official order, and the designation of the malady. The *synoptical table* which follows indicates the number of animals present before the disease appeared, the number affected, as well as that recovered, dead, or killed since its commencement until the date of the report. The sex and age of the animals should also be indicated in separate columns. If the disease has invaded several localities, a special report should be made for each, even if one veterinary inspector has to officiate in them all.

(*b*). Information relative to the occasional causes, and the mode of propagation of the affection.

This section of the report commences with an enumeration of the different influences prevailing when the malady appeared or previous to that event, in so far as they may be found to affect the origin, spread, and other circumstances connected with it. The veterinary surgeon arrives at this knowledge either by a personal investigation of existing conditions—such as the situation of the locality, the disposition of the pastures or habitations, quality of the food and water, mode of management of the animals, &c.—or from information furnished him by some local authority, the owners of animals, their servants, &c.

The questions may in such cases run as follows : When did the malady first appear ? Were one or more at first attacked, and how long a period elapsed before others were affected ? Were these animals standing near each other, or did the disease appear in different parts of the building or farm ? Did it simultaneously invade several habitations at some distance from each other, though in the same locality ? How were the animals when the disease first appeared ? Might any ordinary cause, such as the climate, season, weather, topographical situation of the place and its environs, food, litter, dwellings, pastures, management, utilization, &c., be considered as capable of producing it ? Has this disease, or any resembling it, been previously observed in the locality, or is the present one usually prevalent ? What is the sanitary condition of the animals in the neighbourhood ? Are any among them sick, and to what species do they belong ? Is the prevailing malady similar to theirs, and has it manifested itself before or after it? Has there been any communication or special relations with that neighbourhood ? Did these animals frequent the common pastures with those of the neighbourhood ? Did travelling herds or flocks pass through the locality or nearest road, and if so was any disease observed in them ? Had a fair or market been held in the vicinity shortly before the disease appeared, and were the first cases of sickness observed among animals that had been to that fair or market ? Were these animals first affected,

or those cohabiting with, or standing beside them? Has only one species been affected, or have more? if so, are the symptoms analogous or identical in them all? What were the morbid symptoms first observed? What has been the course and termination of the disease? Has an examination of one or more of the animals which have died, or been purposely slaughtered because diseased, been made? If so what lesions were noted? Has medical treatment been adopted, and, if so, with what result? Have sanitary measures been resorted to, and, if so, what were they, and what benefit has followed their application?

(c) A description of the symptoms and course of the malady. In the description of the symptoms, it is first of all necessary to discover how many animals are sick, their species, age, sex, and to how many farms or owners they may belong—what morbid phenomena the diseased animals present in the earliest as well as in the later stages. If the number of sick is great and the course of the disease varied, then all similar cases should be included in one statement, only the chief differential phenomena observed in the particular forms being noted.

When the veterinary surgeon deputed to investigate and control the outbreak has ascertained the nature of the disease, he should personally visit the farms or other places which the local authorities report as infected. As it may happen that certain cases have not been declared, and that, consequently, should the malady be of a contagious nature, the contagium may be disseminated, it is also highly important that the animals supposed to be healthy should be inspected—a task which is easily and conveniently accomplished when a general census or enumeration of the animals is being taken. This last measure should always be made with the greatest care and minuteness, as much with a view to making known the exact extension of the disease and its mode of development, as to make certain that the measures prescribed have been duly observed, and to prevent all buying and selling of animals during the outbreak. The enumeration which ought to be again made before the locality is declared free from the conta-

gion, should prove whether there has been any clandestine sale or purchase.

If the disease is contagious, great circumspection should be observed in taking this census of the animals, so that its extension be not accelerated. In such a case it is most advisable to take the census of the animals in such places as are yet to all appearance uninfected, before entering the infected localities and proceeding to an enumeration of the cattle therein. And even then it will be most judicious not to enter such places, if possible; but rather to have the animals turned into a court or yard, so that they may be examined at a certain distance.

If on this visit any animal is found to be suffering from a contagious malady, the examination of the other animals should not be proceeded with until the persons who have been in contact with it have been disinfected or have changed their clothes.

After having seen all the animals reported, and which are to all appearance healthy, then those which are suspected, and finally those evidently diseased, are to be visited. If, in order to ascertain the nature of the affection, an inspection of the sick and an examination of dead animals has been necessary, and if it proves to be a contagious malady, then persons who have taken part in these operations ought not, on the same day, to proceed with the enumeration, but defer it to the following or even subsequent days, in the meantime disinfecting themselves and their clothes, which it is generally more safe to change; or otherwise confiding the census-taking to another veterinary surgeon, if one is to be found in the locality. With him may be associated an inhabitant of the locality, in whom confidence can be placed, and whose cattle, if he have any, are still healthy. In this proceeding, the animals in each place belonging to the species affected with the disease should be particularly distinguished with regard to number, sex, colour, age, and breed.

(*d*) *The Pathological Anatomy.*—An inquiry into the pathological alterations produced by the disease is always desirable in establishing the diagnosis of a malady which has just broken out; in many instances the morbid symptoms in the

living animal do not permit of this, and, therefore, the examination of a dead body is absolutely necessary. If at the inspection there are no dead animals at disposal for this purpose, one in an advanced and incurable stage of the malady should be killed for this purpose; indemnity being, of course, allowed, on certain conditions, for animals slaughtered with this object.

In the case of a contagious disease, the examination of dead animals should not be made on infected farms, but if possible at the slaughter or burial-place, or knackers' establishments, should such be found in the vicinity. The precautions already enumerated for preventing the spread of contagion at these places ought to be scrupulously attended to.

In making the examination of a carcass, the greatest circumspection and precision should be observed, as an exact appreciation of all the phenomena and pathological appearances is the best, and indeed the only sure, means of establishing a diagnosis. In order that every competent person may be able to satisfy himself as to the correctness of this diagnosis from the revelations made at the autopsy, the veterinary surgeons should take care not to limit themselves to general terms with regard to the pathological processes and their results—such as inflamed or tuberculous lungs, intestinal Catarrh, &c., but ought to state exactly the appearances on which they rely in giving these designations to the changes observed.

If an examination be made of several carcasses, only a general report need be given, unless something of a special character has been discovered in one or more of them. Then the unusual alterations should be expressly indicated.

(*c*) *Conclusions and Diagnosis.*—After collecting and arranging all this information in the first official report, the nature of the disease has then to be determined; and from a just appreciation of the facts obtained, it will be decided whether it is contagious or non-contagious. The *diagnosis* of the disease, the name of which should be inserted in the proceedings, will be directly arrived at by the study of the morbid symptoms and the *post-mortem* appearances. At the same time,

the *intensity* of the disease should be indicated in the report —its degree of malignity, and the rapidity of its course.

(*f*) *Preventive and Curative Treatment.*—The succeeding portion of the report should comprise the preventive measures and medical treatment. These must, of course, vary with the nature of the malady and, to some extent, with local circumstances. With regard to prevention, mention should be made of the measures which have been adopted with regard to suppressing the causes recognized as occasional. It should be stated whether the food and water given to the animals have been of good quality; if there has been occasion to adopt measures for averting the unhealthy influences exerted by bad dwellings, overcrowding, &c.

The mission of the veterinary surgeon, delegated by authority, is to pronounce as to the existence and nature of the disease, and to set in motion the measures necessary for its extinction. On the proprietors falls the onus of medical treatment. If they confide this task to the official veterinary surgeon (which may be at times advisable), he should briefly and precisely state in his report what remedies have been prescribed for the sick animals, as well as their composition and dose. If with a number of animals a special mode of treatment has been tried, this also should be notified in the report, with its results on different individuals.

In the selection of medicaments, care should be taken that these are not expensive; those which are high-priced ought not to be recommended unless they are absolutely indispensable. Clear and explicit directions should be given for the preparation of those deemed necessary.

(*g*) *Sanitary Measures.*—We have already stated that the rigorous application of sanitary measures is of the utmost value, and that it is only by them that the propagation of contagious diseases can be arrested and finally extinguished. At the commencement of a contagious malady, which may become widespread if submitted to medical treatment, it must of course necessarily be asked whether it would not be in every respect preferable, in order to extinguish it promptly and without much loss, to kill and bury the sick and suspected

animals, as well as destroy the substances which have been in contact with them. In such maladies as Cattle-plague, contagious Pleuro-pneumonia, Glanders, Rabies, and some other diseases, there can be but one answer to this inquiry; with other diseases, it becomes a question of isolation and medical treatment.

The veterinary surgeon should indicate in his official report, and in a special and exact manner, the measures he recommends, or may temporarily have caused to be adopted. Although the nature of these measures should be conformable to the character and contagiousness of the malady to be combated, as well as varied according to circumstances, there are nevertheless those general measures which have been already described, and which can be adopted in every contagious disease.

In this report, mention should be specially made as to whether notification of the existence of the malady, should it prove to be contagious, has been made to the neighbouring localities. In the infected district, the inspection of the animals and their flesh, if this is consumed as food, should be conducted with the greatest care; and it may even be necessary in some outbreaks among animals of the bovine, ovine, or even porcine species, to make the butchers in that district declare where and from whom they purchased their animals for slaughter—whether in or beyond the district.

The report should be signed by the veterinary surgeon and, if deemed advisable, by the other members of the commission. (*See annexed Form of First Report.*)

PERIODICAL REPORTS.

As soon as the veterinary inspector has recognized the existence of a contagious disease in a locality, and the first report has been drawn up and forwarded to the authorities, periodical reports should be transmitted by him with regard to the progress of the malady. These reports should be made as often as the occasion may require: every fortnight for some diseases, and for those of a more serious character every week.

These reports should contain the following information: The name of the district and locality; the date of invasion, declaration, and official authentication of the existence of the disease; the number of animals, &c.; the number of farms infected; that of the animals sick at the last report, and that of those which have sickened within the intervening eight or fifteen days; the number of animals which have died or been killed as sick or suspected, as well as the number remaining under treatment; the total number of those attacked, cured, dead, or killed, from the commencement of the outbreak up to the date of the report; lastly, the total of the losses and the number yet surviving, should be shown in special columns of the report, which should also contain reserve spaces wherein to enter the date on which the disease was declared extinct, the signature of the veterinary surgeon, as well as a column for special observations.

If the same malady is prevalent in several localities, and its management is confided to one veterinary surgeon or one commission, a periodical report should not be drawn up for each locality, but the names of the infected villages or farms should be mentioned in the same table, and in chronological order with respect to the invasion of the disease. Everything relating to each of the localities, however, should be kept distinct. Those localities in which at any time the disease breaks out afresh, should be again indicated; while as soon as it has disappeared from a locality, the name of the place ought no longer to appear in the table, but a terminal report should be drawn up respecting it. (*See annexed Form of Periodical Report.*)

SYNOPTICAL REPORTS.

The synoptical reports transmitted after the first, should, if necessary, be accompanied by other reports in which there will only appear any noteworthy facts that may have transpired in the infected locality since the last inspection and date of last report.

They should contain: (*a*) The special observations made as to the duration, progress, and terminations of the disease; the

consecutive maladies or complications; the causes of the greatest mortality, and the course and mode of propagation of the affection; (*b*) Information as to the result obtained from preventive, suppressive, or curative measures; (*c*) Information relative to the carrying out of the sanitary measures.

If from these reports it is observed that there has been apathy or opposition to the carrying out of the prescribed measures, the persons so offending should be punished according to law. If, for instance, it appears that the early cases at the outbreak of the disease were concealed by the owners of the animals, that the declaration as to its existence was tardily made by these or by the authorities to whom they were first reported, that the diseased animals, or their flesh or products derived from them, have been sold, and that the general prescriptions laid down by law have not been adhered to, the sanitary commission, or the veterinary inspector in his first or subsequent reports, should make known the circumstances to the county or central authorities.

TERMINAL REPORT.

Termination of the disease.

An outbreak of the disease cannot be said to have terminated until there no longer remains a sick or suspected animal, nor until all the dwellings which have been occupied by these, as well as utensils, &c., are disinfected, manure destroyed or buried, and the contagium thoroughly got rid of in every respect. The health and condition of the animals in an infected locality is best ascertained by proceeding to a final inspection and enumeration of them, during which care should be taken to ascertain whether, during the outbreak, any of them have been bought or sold clandestinely.

Even at this time, though no case of disease exists, yet the greatest reserve should be observed in declaring the malady extinguished—at any rate until a certain interval, equal at least to the maximum incubation stage of the affection, has elapsed since the last case; as before this time there can be no certainty that new cases may not occur.

Period of Observation.

The interval above alluded to should be designated the "period of observation;" it will of course vary with the malady, as the incubatory stage varies extremely in different contagious diseases. It should commence with the last case of complete recovery or death.

Termination.

If the disease is at length declared to be terminated in a locality, the neighbouring villages and towns should be informed of the fact, and all the measures of isolation, &c., which have been in force, should be abolished.

Final Report.

Then the veterinary inspector should draw up a terminal report, as complete in facts and details as possible; to this he should annex a tabular report, both being addressed to the district or county authorities, duplicates being transmitted to the central authorities. The following points may be treated in this terminal report:

(*a*) The conditions under which the disease appeared.

(*b*) The symptoms of the disease.

(*c*) Its pathological anatomy.

(*d*) Special observations with regard to the nature, duration, course, terminations, consecutive diseases or complications, cause of death, modes of extension, &c.

(*e*) The preventive and curative measures adopted, and the results obtained.

(*f*) The sanitary measures instituted, and the manner in which they were carried out.

FORM OF FIRST REPORT.

County District Place

Report of an inquiry made by order of into the outbreak of disease among

as announced by the local authorities of in their letter, No. , dated

Number of Cattle (or sheep) before the appearance of the disease.	Number sick from the commencement until date of inquiry.			Number which, before the inquiry, have									At Present Remaining Sick.		
				Recovered.			Died.			Been Killed.					
	Bulls.	Cows.	Calves.	Bulls.	Cows.	Calves.	Bulls.	Cows.	Calves.	Bulls.	Cows.	Calves.	Bulls.	Cows.	Calves.

Causes of the development and extension of the disease :
Symptoms and course of the disease :
Pathological Anatomy :
Diagnosis :
Preventive and curative measures :
Sanitary measures :

FORM OF PERIODICAL REPORT.

District.	
Place.	
Date of: Appearance of Disease.	
Date of: Declaration of Disease.	
Date of: Official recognition of Disease.	
Present No. of Animals (cattle).	
No. of Affected Animals.	
No. of Sick at Last Report.	
Cases since Reported.	
Total Cases of Disease.	
Recovered.	
Dead.	
Killed: Sick.	
Killed: Suspected.	
Remaining.	
No. from commencement to present time: Sick.	
No. from commencement to present time: Recovered.	
No. from commencement to present time: Died.	
No. from commencement to present time: Killed: Sick.	
No. from commencement to present time: Killed: Suspected.	
Total Loss.	
Total Remaining.	
Date of Extinction of the Disease.	
Observations.	

Place and Date.

Signature of Veterinary Inspector.

PART THE THIRD.

SPECIAL CONTAGIOUS DISEASES.

CATTLE-PLAGUE.

SYNONYMS.—Technical: *Pestis bovina*, *Lues bovina*, *Pestis bovina variolosa*, *Febris maligna pestilentialis*, *Lues cornatorum pestifera*, &c. French: *Typhus contagieux*, *Peste bovine*, *Fièvre putride*, *Peste varioleuse*, *Cachexie varioleuse*, *Fièvre continue*, *Typhoïde avec redoublement*, *Peste bovine hongroise*, *Peste de Dalmatie*, &c. German: *Rinderpest*, *Löserdürre*, *Magenseuche*, *Viehpest*, *Viehseuche*, *Rindviehstaupe*, *Rotzpest*, *Uebergalle*, *Pockenseuche*, &c. Netherlandais: *Veepest*, *Veeziekte*, *Runderpest*. Italian: *Tifo bovino*. Chinese: *Low peng* (belly sickness). Burmese: *Puschima*. Hindostanee: *Mar drishtee* (the look of Mother Shetola, the goddess of Small-pox), *Dukina*, *Debee*, *Chechuck*, *Bhowanee*, *Puschima*, *Puschima rog*, *Puschima nara*, *Dosalin* (the plague), *Burrapera* (the great sickness), &c. In Thibet it is designated *Yor* and *Chooneah*. Singhalese: *Pátchana ledé*, *Malabadda ledé*, *Uguru ledé*. Tamil: *Vedippú*, *Paruvu*. Russian: *Tchouma*, *Tchouma reina*.*

GEOGRAPHICAL DISTRIBUTION.

The regions to which the disease is indigenous are not yet definitely ascertained. It is an Asiatic malady, and is per-

* It is curious and important to note the employment of this term by the Russians to designate the Cattle-plague. Reynal has pointed out that it proves, philologically, the region in which the disease originates, or rather permanently reigns—the far East. History demonstrates that the appearance of the disease in early times in Western Europe coincided with the irruptions of the Mongols, and that the contagion accompanied their armies; that the route it has followed in more recent years was that of the Huns, and that it remained with these people in the colony they

haps enzoötic in Southern Russia, the Asiatic Steppes, and different parts of India. It appears in Mongolia, China (South and West), in Cochin-China, Burmah, Hindostan, Persia, Thibet, and Ceylon. It is unknown as yet in America, Australia, New Zealand, and Africa (except Egypt, into which it has been several times imported), and only appears in Europe as an imported and purely contagious malady.*

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founded on the shores of the Caspian Sea. This word *Tchouma* is used by the Mongols and Nomad Tartars of Central Asia to signify a malevolent deity, something of the nature of a vampire; and it has been adopted, with slight modifications, by all the people who have had any relations with that region. Thus, the Osmanli Turks, the Persians, and the Affghans designate the Plague by the word *Taoun*, the etymology of which is evidently derived from *Tchouma*. The Polish expression *Dzuma* is also doubtless from the same source; and the Tartar word *Ryma* is likewise found in the Russian language, with an alteration in its orthography, which Orientalists do not consider important. This interesting fact not only demonstates the Asiatic origin of the disease, but allows it to be followed, through many centuries, with the emigrations of the Mongolian race, and also permits us to discover traces of its importation into the various regions of the East which these people have successively occupied or invaded.

* In recent years, several of the most competent veterinarians have endeavoured to ascertain the home of the Cattle-plague, but without much success. Unterberger (*Einige Worte über die Heimath der Rinderpest*, St. Petersburg, 1864) throws much doubt upon Russia and its Steppes being the source of the malady, and he asserts that it is a purely contagious disease in Russia-in-Europe, and also, perhaps, in the whole Russian empire. It has been seen in the countries of the East mentioned above, and I witnessed a serious outbreak at Hong-Kong, in 1860, among the commissariat cattle collected for the provision of the troops about to proceed to the capture of Peking. So far as Europe is concerned, we may sum up our knowledge of the geographical limits of the disease in the words of Gerlach (*Die Rinderpest*, p. 97):—"Beyond the Russian frontiers, and even in every part of that empire, the Steppes excepted, the Cattle-plague is evidently a purely contagious malady. It is never developed primarily with us, neither in our indigenous cattle nor in those originally from the Steppes, and it has not yet been demonstrated that it may be primarily developed in the Russian Steppes; the most recent observations even tend to prove that in the European portions of these regions, this affection is only present through the transmission of a contagium. Consequently, the Cattle-plague is a malady which is perhaps

CHARACTER.

The Cattle-plague is a febrile and highly contagious disease, primarily developed in the bovine species, but capable

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primarily developed in the Russo-Asiatic Steppes—perhaps elsewhere—but is never seen in Europe except by the importation of its contagious principle."

There can be no doubt whatever as to the existence, and sometimes wide prevalence, of the malady in India, throughout every part of our extensive possessions there, as well as in Ceylon. The voluminous reports and most interesting researches of the last Indian Cattle-plague Commission, and that appointed to investigate the Plague in Ceylon, furnish conclusive evidence in this respect. According to Indian reports, the disease is recognized by various names all over India, and in the Kumaon and Hurdui country (North-West Provinces) it has been known from an early period. "It is said to have been known in the hills and Bhabus forests *from of old;* it is even known in the Snowy Range, and sometimes carries off a large number of jooboos (a cross between the cow and yak); but in such cases the disease is believed to be taken up by the Bhotea traders from the lower country." The malady appears every year in the Kumaon division of the North-West Provinces, and is said to be as well known there as human Small-pox. "When it comes regularly, it is less fatal; but when two or three years have elapsed, it appears in a very virulent form." About half the affected cattle perish.

The malady also prevails in Nepal and Thibet, according to reliable reports.

A person named Jungpen, a cattle doctor and a native of Lassa, in Thibet, testified as follows:—"The *Chooneah* appears in Thibet every four, five, or six years. The disease would remain in one place, provided the diseased cattle were not allowed to go out elsewhere, or their flesh was not sent out of the place; but, if otherwise, the disease is sure to go wherever the diseased animals or flesh go. . . . The disease has been in my country for the last fifty years or so. . . . The disease is supposed to come from a country in the west, from which place the salt is brought to Lassa on yaks and sheep. The Bhooteas call the country to the west, *Chhungsakha* (*Chhung* means 'west,' *sakha* 'salt')." The salt-works here mentioned are on the map in long. 85°, lat. 30°, in a straight line about 150 miles north-west of Mount Everest. Chornapary is about 180 miles west of Sarka, the salt-works, on the borders of a large lake in lat. 36°, long. 81.° Janglachi is about 150 miles west of Lassa, in lat. 29°, long. 88°; the latter place being in long. 91°, lat. 29°. The inhabitants of these different places meet once a year at Sarka, and invariably yaks, sheep, &c., laden with salt, returning to Lassa and elsewhere, become affected with

of transmission to all other ruminants. There are instances recorded of pachyderms offering similar symptoms during the prevalence of the malady; but there is no satisfactory proof that they are susceptible of the infection. Like the Variola of man and the lower animals, it only attacks once in a lifetime, the primary attack conferring subsequent immunity. It is a specific disease, extremely fatal when imported, less so in the regions in which it is most prevalent; and its effects are chiefly concentrated on the mucous membrane lining the air and digestive passages.*

NATURE.

The nature of the disease is not yet perfectly ascertained. By some authorities it has been designated a putrid, typhus, or typhoid fever; by others a diphtheritic, or crouposo-exudative disease, &c.; while others, misled by the cutaneous eruption, have imagined it to be a form of Variola. It differs

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Chooneah or Cattle-plague, and some die on the road. The cattle going from Lassa to the salt-works continue healthy, but those returning become diseased. "The sheep and goats in our country also get the disease, and those wild animals which have feet like cattle (cloven-footed). I have seen in the jungles of Thibet a kind of wild goat dying of *Chooneah*. On one occasion I saw a hundred yaks belonging to the Thibet Rajah die of this disease; and on another occasion I saw, at a watering place in the jungles, ten wild sheep lying dead from *Chooneah*. I know that sheep and yaks that carry salt from the western country sometimes die of *Chooneah* —not at the place where salt is made, but on their way to Lassa. . . . . This is a very fatal disease, and there is scarcely a case of recovery from it. It is something like *matah* (human Small-pox). There are no eruptions in this disease."—Report of Indian Cattle-Plague Commission, p. 260.

The malady is becoming more frequent in India, in consequence of the increased traffic and movement of cattle. In Central China it appears to be enzoötic.

In Ceylon, it appears at uncertain intervals as a widespread and most destructive scourge, and tradition points to its having been introduced into that large island from India. It was imported from the latter into the Andaman Islands in 1868.

* I have in nearly every disease omitted all reference to its history, as this would occupy too much space. Those who are desirous of obtaining information on this subject will find it, from B.C. 1490 to A.D. 1800, in my work "Animal Plagues" (London: Chapman and Hall).

from all these, however, in most important features ; and it is difficult, in the present state of our knowledge, to give an exact definition of its nature, founded on its initial phenomena. Rawitsch, who has endeavoured to define it by certain of its most prominent characteristics, states that it consists in "a disturbance in the nutrition, manifested by hyperplasmasia of the epithelial cells of the skin, the mucous membranes, and their glands, as well as the solitary and agminated follicles, and by the rapid granulo-adipose degeneration of the newly-formed elements."

This definition, of course, is incomplete, as no account is taken of the modifications previously wrought in the organism, and to which these alterations are at least partly due.

CAUSES.

We know nothing for certain of the causes which primarily develop the Cattle-plague, beyond those already alluded to in the first part of this work. In our part of the world, it relies solely for its introduction and diffusion to the presence of a contagium, carried either by animals suffering from the disease, those which have been in contact with them, or media of different kinds which are contaminated with the virus. Once introduced into a country, it spreads from its point of introduction as from a centre ; each newly-infected animal becomes a focus whence the disease may radiate in every direction, and it usually attacks those animals which are nearest these foci. It spreads with more or less rapidity, as the animals or vehicles charged with the contagium are moved about ; and even the air may, within a certain distance, be credited as an active agent in the diffusion of the deadly disease.

SYMPTOMS IN CATTLE.

The Cattle-plague, like some other general diseases, does not offer any exclusive or pathognomic symptoms, but is characterized by a group of functional and anatomical alterations of the different mucous membranes. An exact knowledge of the disease is of the utmost importance, as its extension and consequent ravages can only be arrested through its timely

recognition, and the immediate adoption of the necessary sanitary measures. It is frequently most difficult to diagnose during life, especially if its presence is not suspected. The mode of propagation and the introduction of the disease can only, in many instances, be ascertained at a late period, and when much loss may already have been inflicted. In the majority of cases, the necroscopic examination of an animal which has died, or been purposely killed, is the only means of arriving at a correct diagnosis. Indeed, this is, practically, the surest and safest guide; for in different invasions of the malady, and even in different countries and individuals during the same invasion, there are observed considerable variations in the symptoms with regard to their intensity and extent, as well as in the secondary symptoms. The history of the many invasions of this scourge amply demonstrates the truth of this statement. So that, in tracing the symptomatology of Cattle-plague, it would be out of place in a work like this to describe the manifestations observable in all cases, or yet in any particular instance; but rather give a complete summary of the various material and functional alterations which are generally observed in the course of the disease, arranging them in their order of development, noticing incidentally their constancy or inconstancy, and the co-ordination and intensity of these symptoms.

Benignant Form of Cattle-Plague.

With the cattle indigenous to the regions in which this malady may be said to be enzoötic, the symptoms are frequently but little marked, and the mortality is not great. So much is this the case, that veterinary surgeons who can readily distinguish the disease when it affects the cattle of Western Europe, are extremely embarrassed when it affects animals from Hungary, Bessarabia, Moldavia, or other countries where it is nearly always more or less prevalent. The febrile manifestations are usually of brief duration; signs of fatigue and trifling weakness are, in some instances, the only indications of the presence of this virulent disorder in animals which may, nevertheless, communicate the disease in its most deadly form

to the cattle of other countries. Slight diarrhœa may also be the only symptom ; or this may be accompanied by a feeble febrile action, and a cutaneous eruption complicated or not with gastric disturbance. Or there may be a like loss of appetite, shedding of tears, and a mild degree of prostration accompanying the faint symptoms of fever, and giving a little more precision to the symptomatic indications, more especially if the diarrhœa becomes more intense, and cough is present now and again.

There may be, and undoubtedly there is, an augmentation of temperature, even in this benignant form of the disease ; and should the animals affected be cows giving milk, this secretion will, in the majority of cases, be diminished. This benignant form of the disease is not witnessed when the contagion is imported.

Malignant Form of Cattle-Plague.

In western countries, the malady does not, as a rule, manifest itself suddenly and in all its virulency, but the morbid changes develop themselves in a gradual manner.

1. The initial symptom is generally recognized to be an increase in the temperature of the body, when as yet the stricken animal exhibits no other sign of the disorder.* It usually appears two days before any alterations are noted in the visible mucous membranes ; and while in general it augments during the day, it decreases during the night. The daily variations usually vary from 0·1° to 1° Centigrade. The thermometer introduced into the rectum will show an augmentation of 1° to 2°, and this temperature will sometimes rapidly increase, at times attaining its maximum in twenty-four hours, though more frequently it requires two or three days ; this temperature may be maintained for from one to three days, after which it descends more or less rapidly (even in fatal cases) to the normal standard, and sometimes in certain

* Guyot, in 1774, observed that one of the first manifestations of the disease was increased temperature, discovered by passing the hand into the rectum.—*Paulet :* " Recherches Historique et Physiques sur les Maladies Contagieuses."

patients below it. The morning temperature is generally less than that of the evening.

The close observation of the variations of temperature is of great practical importance, more particularly in a repressive point of view, as it gives a certain indication of a change in health one or two days before any other symptoms are observed. It also enables the course of the malady to be precisely noted, and the results anticipated ; for instance, in animals about to recover, it has been ascertained that the temperature is higher during the fourth and fifth days, but decreases on the sixth or seventh, and this much slower than in those about to die. It has also been noticed that if the temperature in the evening is equal or inferior to that of the morning, or if it falls rapidly below the normal degree, the termination will inevitably be fatal.

Reynal does not think that the elevation of temperature in the prodromic period of the disease, has the absolute value generally accorded to it. If it is true, he observes, that it is noted when the malady appears suddenly with its proper symptoms, and particularly in animals which are in an excellent state of health, it must nevertheless be remarked that it does not present itself with that constancy and generality attributed to it, especially in benignant cases. In the numerous applications he made of the thermometer, he noticed in a group of animals suffering from the disease, that in some there was an elevation of 1° to 2·5°, and in others an oscillation of the thermometer between 38° and 39·5° Cent. (100·4° and 103° Fahr.). He also notes that Gerlach, although attaching a great importance to this symptom, has often observed that the thermometer varied from 32° to 41° (102·2° to 105·8°) without ever exceeding 42° (107·6°); and that from these results, which were similar to those obtained by Reynal himself, he concludes that if, in certain cases, the increase of temperature should be deemed of great importance, it nevertheless does not constitute a pathognomonic prodrome of Cattle-plague. Observation has long ago shown that there is no appreciable febrile tendency in the adynamic form of the disease. The same peculiarity is remarked when the evolution of the disease takes place

slowly, and it gradually and quietly runs its course, as in the Steppe cattle.

2. In milch cows, the increase of temperature is followed by a diminution in the quantity of milk secreted—this alteration usually preceding the appearance of other symptoms by twenty-four to thirty-six hours.* As the disease progresses, the amount yielded decreases, though the secretion is not generally suspended until towards the termination of the malady. The specific gravity of this fluid likewise diminishes, the amount of salts is lessened, while the fatty matter is increased; the quantity of casein remains nearly the same as in health. In some invasions, the milk is reddish-coloured and acrid towards the fourth day.

3. The increase of the temperature, and the diminution in quantity and alteration in quality of the milk, are the only manifestations of disturbance for twenty-four to forty-eight hours. About this time there sometimes appear well-marked shiverings, trembling, and ephemeral muscular contractions, which are variable in their intensity, extent, and situation, affecting the neck, face, limbs, &c., the animal becomes restless, very irritable, tosses its head, is constantly changing its position, and bellows frequently. Often the general sensibility is exaggerated, and in very exceptional instances the commencement of the malady is accompanied by delirium. When confined in a house, the delirious creature strikes with its horns, kicks at everything near it, and allows no person to approach; if at pasture, it runs about as if mad. To these attacks succeed intervals of calm, and even of torpor; the creature stands stupidly staring forward, and at times falls as if dead. The period of torpor having passed, another fit of excitement comes on, and these alternations continue until coma finally sets in.

Not at all unfrequently, the plague-stricken animal shows from the commencement of the malady, in addition to the tremblings and muscular contractions, an extreme degree of indifference to everything, great lassitude, drowsiness, and torpidity.

* This premonitory symptom was also known in the last century, Doazan of Bordeaux having pointed it out in 1774.

These symptoms, however, are not always observed. Usually, at first, they do not appear so suddenly or violently, but gradually and progressively. Twenty-four or forty-eight hours after the secretion of milk has begun to diminish, the animal looks dull, prostrated, and indifferent; it moves lazily, and does not care to follow the herd; the head is carried low, and the ears are somewhat pendulous; a recumbent position is often sought, and there is difficulty in getting up again; and generally blows and chastisement of different kinds produce but little effect. Sometimes, however, the sensibility of certain regions of the body is exaggerated—such as over the loins, the abdomen, knees, the posterior extremities, or even the whole body. Symptoms of colic—such as striking the belly with the hind foot, and frequently looking round to the flank—are at times noticed. These signs of exalted sensibility, which are sometimes the most constant characteristics of the disease in some epizoöties, usually cease from the third to the fifth day, giving place to a greater or less degree of debility.

While these modifications in the nervous functions are taking place, there also appear functional disturbances in the circulatory, respiratory, digestive, and urinary apparatus, and at the same time characteristic alterations develop themselves on the skin.

As it is impossible to separate the disturbances due to the febrile reaction from those arising from the alterations special to the disease, the morbid manifestations in these apparatus are perhaps most conveniently studied without observing this distinction—care being taken to curtail those symptoms, in order to study them collectively, observed in the mucous membranes and the skin, and to notice, in alluding to the disturbance in the circulation, certain febrile manifestations more or less directly related to that function or that of nutrition.

4. At the commencement of the malady, the number of pulsations is frequently little more than normal; at times it is raised from the first, second, and third day of the malady to 80, or in serious cases even to 100 a minute. At first the pulse may be strong, but it soon becomes weak and thready; though it varies at times, the variations coinciding with those

of the temperature: the pulse being very feeble, or even imperceptible, when the temperature deviates considerably above or below the normal degree.

The blood is not at first changed in its physical properties; but at a late period it coagulates less rapidly than in health, and its colour is not so quickly affected by exposure to the air.

During the early days of the disease, the external temperature of the body is not equable nor constant; the horns, ears, and lower extremity of the limbs are sometimes very cold, at other times burning hot. The muffle is also variable in its temperature, and only slightly moist, though rarely dry. The hair is dull and erect, particularly along the spine, and the skin loses its suppleness. There is, in every case, a rapid loss of condition.

5. The number of respirations may be nearly or quite normal during the first days, though it is usually increased from the beginning, and varies in the course of the disease from 20 to 28 per minute. In some epizoöties it may be below the natural number. The respiration soon becomes plaintive, difficult, and more or less abdominal; expiration, which is frequently longer than inspiration, takes place in two periods. In serious cases, and particularly towards the fifth or sixth day, it assumes a special character: the chest is dilated with difficulty; the air passes into the lungs with an audible sound, and the thorax remains dilated for one or two seconds; then follows the expiration, accompanied by a plaintive moan, to be succeeded immediately by a new inspiration.

From the commencement of the affection there is a frequent, short, dry, and apparently painful cough, which, at a later period, becomes moist, and often rattling. An examination of the chest does not reveal anything abnormal, except in some instances indications of emphysema or a slight bronchitis.

6. With regard to digestion, it may be said that the appetite is diminished and capricious from the commencement, and soon disappears altogether. Rumination is at first irre-

gular and slow, and quickly ceases, even before the appetite : a circumstance which accounts for the accumulation of alimentary matters in the rumen observed after death. The animal is thirsty, and can usually swallow without difficulty.

Defecation is natural, though sometimes there exists, from the commencement, a slight degree of constipation—more rarely, trifling diarrhœa. In the former case, the excrements are covered with mucus, and become softened sometimes one or two days before death. In a short time the fæces become semi-fluid, and at length are merely a muddy grayish mucus, or flaky fluid ; on rare occasions they are mixed with blood, and sometimes exhale a fœtid and most repulsive odour. When diarrhœa is present from the beginning, the fæcal matter is at first of the ordinary character, but at a later stage it becomes altered. The evacuations, in some cases, take place involuntarily, and in sudden jets ; usually they are abundant, but frequent. In animals which recover, the diarrhœa is generally less intense than in those which succumb to the disease. As has been mentioned, there are sometimes symptoms of abdominal pain ; in certain cases, tenesmus accompanies the expulsion of the fæces, and owing to the expulsive efforts, the rectum is frequently everted, the mucous membrane, much injected, appearing externally.

At a more advanced period, the rejection of the fæces is more easily performed, and takes place without the animal getting up, should it be lying ; later still, the excrements are quite fluid, and flow from the anus, which is nearly always or continually relaxed.

The fæces are neutral or slightly alkaline in their chemical reaction—never acid.

7. The urine is generally lessened in quantity, and modified in quality, the amount of urea being increased, and the earthy salts diminished. The specific gravity of this excretion diminishes during the progress of the disease, and the increase of the urea closely follows the rise in the temperature of the body, though it does not attain its maximum until a day later than the latter.

8. With regard to the mucous membranes and skin, there is

much that is not only interesting, but of the greatest practical importance in the way of diagnosis. The development of the symptoms just enumerated are soon accompanied by anatomical and functional alterations of these membranes, but especially of that lining the vagina and the digestive and respiratory tracts.

The vulvo-vaginal membrane is most frequently that which exhibits these changes. It is more or less infiltrated, and of a brown, brick-red, or mahogany colour, which is either disposed in streaks, patches, or diffused; and there may be small sanguine extravasations, variable in number. This abnormal colour, which is more particularly due to venous injection, has in calves and heifers a greater diagnostic value than in cows, as it is observed, though in a less degree, in animals which are near calving, as well as those which have lately calved.

This symptom, however, is not always observed at the commencement of the disease, but may only appear at an advanced stage. Twenty-four hours after its appearance, there are usually seen on the red surfaces small yellow or grayish and slightly salient patches, which might be mistaken for little flakes of mucus, though they are really composed of masses of altered epithelial cells. They adhere but slightly to the dermal surface of the membrane, or are merely lying on it; they are quickly removed by friction, or thrown off by the alterations going on, leaving excoriations corresponding to the situation they occupied. At this period, or a little later, there flows from the vulva a variable quantity of clear or ropy mucus, which, in drying, adheres to the neighbouring parts.

While this alteration is going on in the vaginal membrane, or before or after, other analogous changes are observed in the other visible membranes. That of the mouth is more or less hot, and generally, or in patches of variable extent, assumes a deep red, livid, or dark-blue tint, particularly about the gums; though the presence of pigment may conceal this coloration. Ordinarily, the derm of this membrane and its epithelium are tumefied at certain points, and the adhesion of these two layers to each other is diminished. In a very brief space there appear, at first on the lips and gums, afterwards on the palate

and borders and sides of the tongue, little whitish-gray or yellowish elevations the size of a pin-head, due to the proliferation, infiltration, and fatty degeneration of the epithelium in these localities. The number and dimensions of these elevations increase, and sometimes they join each other; their connection with the derm becomes lessened, and soon—frequently within twenty-four hours—the slightest rubbing will remove them in the form of a soft gray mass not unlike bran; they are also thrown off by the morbid process going on. However removed, the derm upon which they were formed is exposed, and in this way are produced those excoriations whose sharply-defined bright red colour contrasts strikingly with the livid membrane surrounding them. These are the "pestilential erosions of Kausch:"* so named from the veterinarian who first described them.

These epithelial alterations occur, at times, at the base of the papillæ of the cheeks as early as the appearance of the first morbid symptoms; though, as a rule, it is only towards the second, third, or fourth day that they are most marked.

The secretion of saliva is increased, and flows in large viscid streams from the mouth.

The nasal mucous membrane is also greatly injected from the commencement of the affection, and becomes infiltrated and swollen; soon after, it becomes uniformly pale, or in such a manner as to leave injected streaks or patches; petechiæ also appear in variable number. Towards from the second to the fourth day, on examining this membrane closely, it will be noticed that there are the same pulpy or caseous epithelial collections observed on the membrane of the mouth and the vulvo-vaginal membrane, and which when thrown off leave the derm exposed. In about twenty-four hours after the more evident signs of the disease have appeared, a nasal discharge manifests itself; this is at first serous and transparent, but ere long becomes a thick mucus or muco-purulent yellowish matter, which may be mixed with blood, and disagreeably fœtid. In drying around the nostrils, it forms thick crusts.

* Originalbemerkungen über die beiden Rindvichsterben. Leipzic, 1790.

The conjunctivæ of the eyes are also infiltrated, and deeper coloured—particularly about the free border of the nictitating membrane—than usual; but this coloration most frequently disappears in the course of the malady, and this membrane is then pale. The secretion of tears is very copious, and, flowing in abundance down the face, by their acridity they may depilate and erode the skin. A thick muco-purulent fluid collects in the inner canthus of the eye and behind the membrana nictitans, and as the animal becomes emaciated and the eyeball sinks towards the bottom of the orbit, this accumulates.

The skin, which is usually lax shortly after the invasion of the malady, in the majority of cases, and in many epizoöties, becomes the seat of a diversely characterized eruption, which has been at one time described as squamous, at another papular, vesicular, or pustular, and again as erysipelatous. This cutaneous manifestation more especially appears in those parts where the integument is thin, though it may also invade other regions, or even affect the entire surface of the body. The udder, and particularly the base of the teats, the scrotum, the margin of the nostrils, the lips and the vulva, the perineum, and the internal aspect of the thighs, are the localities for which it seems to have a special predilection; but it may likewise be often enough noted between the jaws, on the shoulders, neck, and withers. The extent and intensity of these exanthemata are very variable. At times they accompany the ordinary symptoms, while at others the eruption is coincident with an intense febrile reaction which lasts for some days, and increased temperature of the skin where it is about to appear, with, in certain instances, a more or less abundant transpiration.

This exanthema of Cattle-plague consists of: (1) a proliferation and abundant desquamation of the epidermis, accompanied by shedding of the hair; (2) the production of small papulæ or nodosities, from which exudes a yellow viscid fluid which, in drying, forms, with the hair, crusts of variable thickness; (3) the eruption of little vesicles about the muffle, whose contents agglutinates the hairs and gives rise to brownish-yellow crusts; (4) the formation of pustules (the so-called "variola" of

Ramazzini) the size of a millet-seed or small pea, frequently confluent, and when ruptured and their contents desiccated, producing friable, yellow, or brown crusts, which adhere very slightly to the skin.* The duration of the eruption is variable, but in general it does not entirely disappear until from two to four weeks after its manifestation.

In some epizoöties, erysipelatous tumours have been remarked about the neck, dewlap, or flanks. Gas is also developed sometimes in the subcutaneous cellular tissue—ordinarily in the region of the loins, shoulders, sides, or neck, and in rare cases over the entire body; its presence is recognized by a more or less voluminous tumour which crepitates on manipulation.

Abortion may or may not be the result of the malady, if the animals are pregnant; if this accident does not occur, the young creatures are so weak when born that they soon perish.

Pathognomonic Symptoms.

The above-enumerated symptoms constitute the group of phenomena which mark the course of the malady. But, as has been stated, none of them are really pathognomonic of the Cattle-plague, as none of them belong exclusively to that disease. All may be observed during an epizoöty; but it is rare, indeed, that all are witnessed in the same animal. Differences in breed, season, climate, régime, and other circumstances may greatly modify the manifestations of the malady, not only with regard to its intensity, but also in respect to the succession of the phenomena. Sometimes the signs are so slight and ephemeral, particularly in Steppe-bred animals,

* For a particular description of this eruption, see the Third Report of the Cattle-plague Commission, and, best of all, the excellent Monograph on this malady by my friend Professor Wehenkel, of the Brussels Veterinary School, entitled "Symptomes, Lésions Anatomiques, Causes et Nature du Typhus Contagieux" (Brussels, 1870). To this work, which contains a complete summary of our present knowledge concerning the pest, I am indebted for much of the above description. See also a clever little treatise on the same subject by M. Dèle, of Antwerp ("Du Typhus Contagieux Epizoötique": Brussels, 1870).

that illness is scarcely suspected; at other times, and especially when the malady is imported, they are so grave as to characterize the disease at once—the majority of the symptoms being developed simultaneously or successively, and in such a manner that, to confirm the diagnosis, nothing more is required than the examination of a dead animal.

It is owing to the variations in intensity, to the presence or absence, or early or late appearance, of certain symptoms, that the diversity in the character of this disease is due. On the predominance of one or other group of symptoms, different forms of Cattle-plague have been described: as, for instance, the "nervous," "pulmonary," "gastric," and "exanthematic." The history of the malady amply corroborates this statement.

The nervous phenomena, though the most constant, are not always the same in intensity. Sometimes there is a loss of sensibility, at other times this is exaggerated, particularly in certain regions, and sometimes in the early stage of the disease the animals may be so delirious that they appear as if affected with the violent form of Rabies. The degree of fever is also variable, as well as the extent and intensity of the mucous membrane and skin derangement. It is the same with the alvine dejections and the disturbance in the respiration. Cough and embarrassed breathing are, though present, not equally noticeable in all animals. If pulmonary emphysema appears at all, it is usually about the third or fourth day, and when the dyspnœa is great then we have usually subcutaneous emphysema added to the other symptoms. If dyspnœa is not present while the animals are resting, it soon appears on exertion.

Even the period of development of the symptoms is extremely variable, and may greatly alter the physiognomy of the disease. The increase of temperature, for example, is of the highest value as an initial symptom of the disease, and is frequently followed by a diminution in the quantity of milk secreted; but in some cases this is not observed for two or three days after the other morbid changes have been noted. Sometimes it is the loss of appetite, sometimes the cough, which first attracts attention. Prostration, weakness, muscular

contractions, alterations in some one or other, or all of the mucous membranes, digestive derangement, and dyspnœa, are generally developed about the second or third day. The cutaneous eruptions, non-emphysematous tumours, and emphysema, are only observed about the fifth to the seventh day; and while the eruptions very frequently portend a prompt and favourable termination, emphysema is only too often the precursory sign of death.

COURSE AND TERMINATIONS.

The irregularity in the appearance and evolution of the different symptoms is in singular contrast with the regularity with which they are manifested in the majority of contagious eruptive diseases; though Cattle-plague has, otherwise, marked analogies to them.

The progress and termination of the malady are somewhat as follows: Twenty-four to thirty-six hours after the increase of temperature has been observed, and when usually the secretion of milk is already diminished, the first alterations in the mucous membrane, fever, nervous disturbance, a dry cough, often dypsnœa, as well as anorexia, are generally very rapidly declared; though there is nothing fixed as to the order in which they appear. The changes in the mucous membranes occur quickly, and two or three days are sufficient for their development. Within the same period, the respiratory and digestive troubles—sometimes the one, sometimes the other being most prominent—complicate and aggravate the symptoms. In about four or five days these different manifestations usually attain their maximum of development, though sometimes the progress of the disease is much more rapid, and the various alterations may acquire their greatest intensity, and death may even take place, within twenty-four hours.

The course of the malady is generally more rapid in animals kept in stables than with those living in the open air, and cold weather lengthens its duration.

The disease terminates by recovery or death.

1. *Recovery.*

As has been stated above, under certain conditions of breed,

climate, and probably other causes which are not yet well defined, the malady may assume a much less serious character than it usually does in our regions, showing itself in so benignant a form that recovery is, in many cases, the ordinary termination.

This recovery may take place at any stage of the malady, and be sudden and unexpected. In such a case there is a diminution of temperature, which usually precedes by a day the amelioration in the other symptoms; the pulse assumes its normal beat, prostration disappears, and the animal is more lively and bright-looking; the secretion of milk is gradually increased, and the appetite and rumination return; the alterations in the mucous membranes disappear, the erosions are covered with epithelium, the infiltrations, congestions, and discharges gradually vanish; the mucus at times accumulated in the trachea and the bronchia is got rid of by coughing; and the diarrhœa, which is ordinarily the most persistent symptom, becomes less profuse, and the fæces resume their natural appearance. If the management is favourable, animals quickly recover their lost condition.

In favourable cases, the amelioration is often indicated by a greater activity in the functions of the skin, which is more or less covered with perspiration; or an eruption in one of the forms described may appear, though this is by no means an infallible index of recovery.

The progress in the recovery is not always uniform; before it is perfect, there sometimes occurs a check which may continue for a variable period, or there may even be a relapse; this is evidenced by a new and sudden rise in temperature, an increase of fever, a diminution in the appetite, &c. These checks and relapses are generally attributed to an excess of food ingested at a time when, though the appetite has returned, the digestive organs are not in a condition to assume their functions.

And in the course of the disease there sometimes arise disturbances which remain after it has disappeared; as, for instance, pulmonary emphysema and digestive disorders, such

as frequent diarrhœa and attacks of indigestion, which may persist for some time after recovery from the malady.

2. *Death.*

The fatal termination of the disease is much more frequent in western countries than recovery. Dissolution sometimes occurs quite suddenly, and as if from apoplexy, in one or two days; at other times the animals succumb about the third, but most commonly from the fourth to the seventh day, rarely later, unless there has been a relapse. In the first case, there are often found dead in the cattle-sheds in the morning, animals which did not appear to be ailing the previous evening; while in others, the very rapid development of the morbid signs can be followed until death quickly ensues. When the course of the malady is less rapid, many or all of the symptoms described appear within two or three days, their extension and intensity continually increasing; the increase of temperature, after attaining its maximum, is ordinarily followed by a rapid diminution, even to less than the normal degree. And this temperature, instead of increasing regularly from the morning towards the evening, and falling during the night, remains stationary in the day-time or even decreases. The lacteal secretion ceases, muscular rigors, abnormal movements, hyperæsthesia of certain regions or the whole surface of the body, restlessness and irritability, and even indications of vertigo and delirium, after more or less rapidly reaching their maximum of intensity, subside and give place to apathy, debility, nonchalance, and coma. The debility increases until the animals can scarcely stand; when down, they get up again with great difficulty, and there is much grinding of the teeth. Every attitude expresses suffering, and external irritation or pain are unheeded; this is shown by the swarms of flies which obtain undisturbed possession of the surface of the body. The fever becomes more of a typhoid character; the pulse is small and filiform, or even imperceptible; the beats of the heart can scarcely be heard; the respiration is hurried and difficult, and emaciation occurs with wonderful rapidity.

The changes in the mucous membranes which are developed within two or three days, become more extensive and serious; lachrymation is more abundant, and the muco-purulent deposits in the eyes form quite a striking characteristic; the nasal discharge is mucous or muco-purulent, and sometimes fœtid and bloody; saliva flows copiously from the mouth, and a muco-purulent secretion is discharged from the vagina, and dries around the lips of the vulva. Rumination, which is more or less suspended from the commencement of the malady, soon ceases; though the appetite may not be entirely in abeyance until some time after. About the second or third day—at times twenty-four to forty-eight hours later—diarrhœa succeeds the slight constipation frequently noticed at the commencement of the disease. The fæces contain some alimentary *débris*, and do not differ in colour from those passed in health; before long, however, they are of a grayish-yellow tint, and are composed of a more or less serous or mucous fluid often tinged with blood, in which are suspended flocculent masses, or clots of blood. Defecation, usually accompanied at first by tenesmus and partial eversion of the rectum, becomes frequent but scanty, and at last involuntary, the fæcal matters flowing from the constantly relaxed anus. When death is near, a disagreeable odour is given off by the mouth; the respiration is more hurried, difficult, and plaintive; the cough loses its energy as the debility increases, and sometimes after a fit of convulsions, the animal perishes in a state of profound coma.

In some epizoöties, subcutaneous emphysema usually precedes death.

SYMPTOMS IN THE SHEEP AND GOAT.

For a long time it was believed that this disease was confined to bovine animals, and that other ruminants were exempt from its ravages. Now there is sufficient evidence to prove that all ruminants may become infected—even deer and camels. Sauvages in the last century, Jessen, Sergejew, Paschkewitsch, and Röll in this century, had noticed the susceptibility of sheep and goats; but the observations of Maresch

in Prague, Galambos in Hungary, Simonds in England, and Leblanc and Bouley in France, and other observers in Belgium and Holland, as well as in Scotland, have fully established the fact that these and other ruminating creatures suffer from the contagion, which is always communicated to them by natural infection or inoculation. From them, the disease may be again transmitted to their own species and to bovine animals.

In the sheep and goat the malady is not very common, and these creatures are far less susceptible of infection than cattle; while the action of the contagium is not so intense in them. The closest contact with diseased bovines will frequently not produce the malady in the ovine and caprine species, and even inoculation is not always successful. When the disease prevailed among cattle in Bohemia, Carniola, and the adjacent coast, scarcely more than twenty per cent. of the sheep exposed to the contagion contracted the disease; and in Vienna, forty-five per cent. of those inoculated remained refractory to the action of the contagium. Certain, though unknown, circumstances would, however, appear to influence the transmission. For instance, in some epizoöties goats and sheep will remain unaffected, while in others a somewhat large percentage may suffer. Röll states that during the prevalence of Cattle-plague in Poland, in several localities of one district, seventy-four per cent. of the ovine population contracted the disease.

Hygiènic influences would also appear to have a share not only in predisposing sheep and goats to the disease, but also in increasing its virulency. Viseur reports that at Auchy-lez-Labas-sée (Pas-de-Calais), France, during the existence of Cattle-plague in that country in 1871, the disease was communicated by cows to a flock of four hundred sheep. These animals were greatly overcrowded, and this agglomeration appears to have concentrated the virus and endowed it with very destructive powers; for in less than eight days sixty-three were dead. About sixty yards from these were fifteen sheep, separated because of lameness and for other reasons, and lodged in a large airy place; these creatures remained unaffected, and to avoid danger, this veterinarian always after-

wards recommended that large flocks should be divided into lots when they appeared to be overcrowded.

In general, the first observed disturbance in the health is: debility, diminution of appetite and rumination, ceasing to bleat, drooping ears, and acceleration of the pulse and respiratory movements. It is but rarely that any unusual nervous excitement is noted at the commencement; and there is no doubt that, as in the ox tribe, the temperature is increased before any change in the state of the animal is observed. If the disease progresses, the debility increases, and the appetite and rumination cease; deep congestion of the buccal, nasal, and conjunctival mucous membrane is visible, tears flow down the face, and in a short time an abundant discharge occurs from the eyes and nostrils, with a viscid saliva from the mouth. Nearly always there appear red spots on the inner surface of the lips, and on the gums, which later are covered with a cheesy exudate. The respiration—accompanied at each act with jerking of the head—and the pulse are more hurried, and a short, husky, painful cough is heard. In many cases, cough is an early symptom, and is readily excited by causing the animal to move hurriedly. Grinding of the teeth is frequent, the tail appears to be paralyzed, and the fæces, at first soft, then pulpy, become at last liquid and reddish, rarely sanguinolent. Diarrhœa, however, is not a constant symptom, sometimes not one-half the affected sheep suffering from it. Debility and emaciation progress rapidly, and the animals are nearly always lying, and rising with great difficulty they stagger about; the eyes are nearly closed, and in some cases a papular and erythematous eruption appears around the anus and vagina, and on the perineum and udder.

In many instances these symptoms never advance beyond a moderate intensity, and the animals recover; in other cases, recovery takes place even when the symptoms appear so serious that death seems to be imminent. If a favourable change occurs, and the animals are lying on the litter in a state of extreme prostration and almost unconsciousness, sometimes the first indication of rallying is their commencing to smell the fæces, and the eyes becoming more lively and

expressive; the next day the appetite returns, thirst is manifested, the pulse and breathing gradually regain their normal standard, and the cough disappears; though the fæces, becoming gradually darker, may remain soft for some days. The nasal discharge and the formation of crusts gradually diminish, and disappear in about ten or twelve days; but the condition is not regained until later.

If death takes place, it is ordinarily from the third to the fourth day, sometimes later. Animals in a state of convalescence, after exhibiting most serious symptoms, not unfrequently die from exhaustion about the fourteenth day.

PATHOLOGICAL ANATOMY.

Among the anatomo-pathological lesions observed after death, there are several which are no more constant than the majority of the symptoms; nevertheless, taking them altogether, their value is very great in establishing a diagnosis. The age and general condition, the state in which the animals were kept before they were affected, their breed, the character and intensity of the disease—all appear to have some influence on the seat and seriousness of the lesions. These will also vary, of course, according to the period at which death takes place.

If an animal is killed at the commencement of the malady, and the symptoms have been comparatively mild, there will, nevertheless, be found on examination after death, such alterations in the mucous membranes as congestion and ecchymoses. The latter are more particularly observed on the free border of the mucous folds in the fourth compartment of the stomach (true stomach) and around the pylorus, although they also exist to a less degree in the small intestine, and often in the vagina.

When, however, an animal has died from the disease, or been killed when it had attained a certain degree of intensity, the changes are more characteristic; the body becomes quickly inflated after death, and sometimes even before that event. The rectum is everted, and its lining membrane is tumefied and of a deep red colour; the tail and hinder extremities are more or

less paralyzed during life, and are therefore usually soiled by the fæces. The skin exhibits the eruption before mentioned, and in those places where there are neither glands nor hairs, as on the teats, it is injected in irregular patches of variable dimensions; the epithelium is thickened, soft or friable, and the integument is often cracked. When the skin is removed, the vessels which are cut are generally filled with a dark-coloured fluid blood, and the flesh is red, blue, or violet-tinted. The peritoneum in certain cases may be slightly injected, or ecchymosed in patches. The external surface of the stomach and intestines does not offer anything particular, except that in places the small intestine may be reddened. The whole of the intestines are generally greatly distended with gas.

It is in the interior of the digestive canal that are found the most marked evidences of the disease; though these are not always the same in any period of the malady, neither are they equally constant or intense in every portion of the mucous membrane. In the mouth, pharynx, true stomach, small intestine, and rectum, they are most frequently present; they are least conspicuous or most often absent in the œsophagus, the three first compartments of the stomach, and in the cæcum and colon. The lesions may be so trifling (as in the Hungarian or Steppe cattle), that they resemble those of an acute Catarrh; while in other instances they are unmistakable and pathognomonic.

In the mouth and pharynx are observed the alterations in the lining membrane and the epithelial changes already referred to. These may be more or less intense and extensive in different parts of the mouth and pharynx; but it is chiefly where there has been much friction or local irritation that they are most exaggerated, and deep erosions, with loss of texture of the derm of the mucous membrane, may be noted.

The œsophagus is rarely affected, though it is not always exempt. Its epithelium is generally more easily detached than in health, and if the alterations are more serious they resemble those of the mouth.

In the rumen the quantity of food may be a little larger than usual, from the cause mentioned. The epithelium on

the mucous membrane lining it and the next compartment may be more easily detached than in a healthy state, and a microscopical examination of the cells proves them to have undergone a similar change to those of the mouth. The mucous membrane of these compartments is also frequently injected in a general manner, though more deeply in some places than others. Neither is it rare to find on this membrane round, oval, or irregular-shaped eschars, disposed separately or in groups, and varying in colour from a dark-brown to a greenish hue. The elimination of these eschars takes place gradually from around their well-defined borders, and cicatrization afterwards occurs, even in cases which have a fatal termination. Submucous extravasation is probably the cause of these gangrenous patches. Around them the tissues are infiltrated and more or less injected, while beneath the texture is injected or ecchymosed, and red or green in colour.

The third compartment sometimes contains food which is hard, dry, and friable; at other times it is soft and pulpy. In the first case the epithelium of the leaves is readily detached, and adheres to the cakes of aliment removed from between them. This epithelium also exhibits granulo-adipose degeneration. The leaves themselves are injected wholly or partially, and ecchymoses and eschars may be present in them; they are also easily torn. It has to be remarked, however, that these alterations are more rare and less marked if the contents of the compartment are soft; and that the differences in the physical character of these contents depend neither on the gravity of the disease, nor on the stage at which it has arrived, but on the nature and quantity of the food and drink ingested.

In the fourth compartment and small intestines, the contents are at first normal, but they soon change, and there is found a small quantity of thick, yellow, brown, or even blood-coloured fluid. The mucous membrane is covered by a viscid, grayish-yellow, or reddish mucus. The cæcum and colon at this period contain a frothy mass of a brownish, sometimes sanguinolent, fluid. The rectum has a thick viscid mucus adhering to its inner surface. If the disease pursues its course,

the débris detached from the intestine is mixed with exudations and extravasations to form a viscid, albuminoid, whitish-yellow, brown, or red fluid, in which are shreds and the detritus from the membrane. The contents of the three first compartments have an alkaline, that of the fourth compartment an acid, reaction.

When, in an animal which has been killed at the commencement of the disease, the mucus has been carefully removed from the mucous membrane of the true stomach, it is found that the surface of the latter is irregular, and that its tissue is infiltrated and injected to a degree corresponding with the seriousness of the attack and the stage the malady has reached; the abnormal colour, varying from a brick-red to a reddish-brown, is generally diffuse, but is most marked at the pyloric portion, attaining its maximum of intensity towards the free border of the folds; submucous extravasations are also frequently met with in this part, differing in size from a fine point to a large patch. The extravasation at times extends to the surface of the membrane, and the blood is mixed with the contents of the stomach, or forms clots adhering more or less closely to its walls. These vascular lesions are in general more intense towards the third or fourth day of the disease; at a later period they are less marked. The infiltration of the mucous and submucous tissue is sometimes very considerable, particularly about the first period; afterwards it diminishes. The wall of the stomach is very friable.

In the small and the large intestines there also exist, at this period, analogous alterations; but while the redness of the abomasum is usually diffuse, in the small intestine it generally appears in the form of transverse striæ, which are crossed by lighter coloured longitudinal streaks—this intercrossing forming a somewhat regular pattern.

Extravasations of blood, generally of small extent, are common in the small intestine, but the infiltrations and exudations are not so frequent as in the abomasum. In the duodenum the alterations are usually more intense than in the remainder of this intestine, and it is not rare to find in it a very marked diffused redness and much sanguine effusion.

Very often the congestion is greatest around the solitary glands and Peyer's patches, whose volume is more or less increased. Frequently the areolated aspect of these patches is already most conspicuous at the termination of the first period.

The same lesions are found, but in a less degree, in the large intestine. Their intensity diminishes from the first portion of the large colon to the rectum, where the pathological redness, the ecchymoses, and the infiltration again appear with all their severity and constancy.

In the large intestines, the most salient portions, such as the borders of the valvulæ, are the parts which are most deeply coloured and most extensively ecchymosed. The infiltration is greatest if diarrhœa has not been present.

Should the disease have made greater progress, the lesions are still more characteristic. The mucous membrane of the abomasum and intestine is deeper coloured, often blue or dark, and in the duodenum of animals which have succumbed, it may even be uniformly black while the petechiæ and ecchymoses are more numerous. In the abomasum, but oftenest in the intestine, towards the fifth day of the disease, there appears a pigmentation, varying from a bright gray to a slate-colour, or even darker, and which takes the place of the abnormal colour due to the blood. This appearance, the intensity and extent of which are very variable, is ordinarily first noticed in the rectum; and in the intestines generally its tint seems to be related to the intensity of the blood coloration, of which these parts have been the seat. It is consequently in the duodenum, and especially near the pylorus, that it is deepest tinted and most extensive: being less so in the other portions of the small intestine, and scarcely perceptible in the cæcum and colon, but intense in the rectum. In the duodenum it is diffuse, but in the remainder of the small intestine it is limited, as a rule, to a double series of perpendicular zones more or less incomplete, and in the rectum is usually in the form of longitudinal lines.

This colouring matter is deposited in the most superficial layer of the mucous membrane, and is constituted by minute

irregular granules, which, according as they are disposed separately or in clusters, give rise to the different shades. Around the orifices of Brunner's glands, and in the texture of the villi, this deposit appears to be most localized. Its presence has only been observed in the digestive mucous membrane and the mesenteric glands, and it would appear to be composed chemically of sulphate of iron.

The epithelium of the fourth compartment of the stomach rapidly undergoes changes analogous to those observed in the mouth. Their intensity depends upon the part examined, as well as the gravity of the attack and its stage. In the first and last portions of the small intestine, in the cæcum, in the first section of the large colon, and in the rectum, they are generally more developed than elsewhere.

In an early stage of the malady, or in slight cases, the epithelium, though not yet detached, is, nevertheless, always less adherent to the derm than in health. In more serious cases, on examining animals which have been killed or have died, this layer is found completely detached over a more or less considerable surface, and especially in the small intestine. The excoriations thus produced vary considerably, as well in extent as in number, and are generally covered by the gray, red, or dark-coloured viscid mucus which has been spoken of. In these places this matter is very tenacious, and adheres firmly in flakes to the membrane, whose texture it invades to about the depth of a line. The extent of these flakes is generally from a quarter to two inches long, though at times they may assume greater dimensions, and even form tubular masses within the intestine.* They are principally met with on the sides and free border of the rugæ ; and if small, they are mostly round or oval ; but if larger, without assuming the cylindrical form, their contour is irregular. The colour is gray, yellow, red, brown, or black ; their free surface is smooth, and

* This was a very noticeable feature in the epizoöty of Cattle-plague I witnessed in China in 1860. Many of the pseudo-membranous tubes removed from the intestine measured six, eight, and ten inches in length. Deep erosions and ulcerations, extending through the mucous membrane, were also met with.

more or less convex; their variable consistency is less at the border than the centre, as is also their adherence to the membrane beneath them, which is injected and spotted with small extravasations; and their margin, circumscribed by the normal or slightly infiltrated tissue, is generally, in consequence of the retraction of the flake, separated for a short space from the border of the erosion.

The elimination or liquefaction of this pseudo-membrane commences at the periphery, and extends towards the centre.

The mortification which may invade the intestinal wall does not usually go beyond the mucous membrane; and while it may only involve the superficial layers of this, at times it attacks its entire texture; and in rare, but very acute cases, it extends to the submucous connective tissue, or even to the muscular layer.

The elimination or liquefaction of the mortified patches causes a loss of substance in the membrane, and these places have been designated "excoriations" or "erosions," according as the derm remained intact or not. The number of these erosions or excoriations is as variable as that of the patches; their outline resembles the latter, and at the bottom are often observed (by means of the microscope) the remains of the glandular *culs-de-sac.*

The viscid masses covering the surface of the intestine, as well as the flakes, are produced by the utricular glands of the gastric and intestinal mucous membrane, which are greatly altered and tumefied.*

* For minute descriptions of these alterations, *see* Wehenkel's monograph; also Brauell's "Neue Unters. betreff. die Pathol. Anatom. der Rinderpest," Gerlach's "Rinderpest," and Albrecht's description of the disease in the Magazin f. Thierheilkunde, 1867.

The latest observations on the pathological anatomy of Cattle-plague, are those of Damaschino, who has made, according to Reynal, a complete study of the histological alterations occurring in the disease. To these we may briefly refer. This investigator states that the ulceration of the mucous membrane is due to an unique process, which offers a great resemblance to that of pharyngeal Diphtheria of man. At the commencement, the lesion consists in an exaggerated production of epithelial cells, which

On the mucous membrane of the abomasum and intestine, spherical nodosities are frequently discovered; these vary in

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are infiltrated with an amorphous substance, become deformed, throw out multiple prolongations, and acquire an abnormal adhesion, which finally gives them a pseudo-membranous aspect. But beneath these false membranes, the young epithelial cells do not submit to the same alterations. Instead of the prolongations adhering to each other and becoming matted together, they are the seat of a purulent transformation, whence results less adhesiveness, and soon the casting-off of the pseudo-membrane. At this moment ulceration commences, and as these tissues are softened, it happens that there is found implanted on this surface fragments of hairs, which are recognized by the microscope. The loss of substance is not always superficial. On the tongue sometimes the lesion ceases at a portion only of the thickness of the papillæ; but in other cases it extends throughout their texture. In the stomach it is often deeper, comprising a portion of the substance of the glandulæ, and even the entire thickness of the mucous membrane to such a degree that, without the presence of a thick layer of adipose tissue at these points, the stomach would be frequently found perforated. On the surface of these ulcerations, the adipose tissue exhibits all the characters of inflammation proper (nuclear proliferation in the conjunctival parietes). In two cases there was found a lesion of the renal and hepatic parenchyma, consisting in a granular degeneration of the glandular elements. In the liver, the lesion, as is usual, showed a predilection for the periphery of the lobules in the vicinity of the vena portæ; there the cells were in a very advanced stage of granular degeneration. The epithelium of the kidneys, more especially, showed the peculiar tumefied troubled appearance already indicated, though the granular condition was less marked.

The muscular alterations consisted in the presence of numerous elongated bodies, very abundant in the right side of the heart, and incontestably situated in the substance of the muscular fibre. These bodies are blunt at one end, pointed at the other, and are composed of a regular mass of cylindrical cells, lying together in such a manner that at the pointed extremity there is only a single cell, at the obtuse end two cells, and in the other part sometimes two, sometimes three cells, clustered on a given segment. It is surmised that these minute bodies are entozoa in their primary stage of development.—*Traité de la Police Sanitaire des Animaux Domestiques*, 1873, p. 236.

We may also notice the investigations of Klebs on the anatomical lesions of Cattle-plague. He appears to consider the alterations present as due to micrococci. The epithelium on the summits of the fungiforum papillæ become disintegrated by immigration of micrococci from the surface, the blood-vessels and lymphatics of the mucous membrane becoming

size from a small lentil to that of a pea, or larger; they are white, yellow, or brown, and lie in groups or are isolated, and

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gradually filled with micrococci; these latter are regularly distributed through the mucosa, the cells of which commence to proliferate in consequence. In the very resisting epithelium of the hooked papillæ, there appears a system of communicating cavities, which at first contain only masses of micrococci; but afterwards, owing to a transudation from the blood-vessels, serum and lymphoid cells likewise. The ducts of the labial mucous glands become the seat of a very abundant accumulation of micrococci, which, in all likelihood, penetrate into the surrounding connective tissue and blood-vessels; thus producing in the former proliferation, in the latter emigration of the cellular elements. He classifies the different regions in which the lesions are found as follows :—

I. *Buccal Cavity.*—1. The earliest lesions appear at those points where the fragments of food lodge (gums, base of the lingual papillæ, &c.); they involve the epithelium, and seem to be produced by the penetration of the micrococci, to which the food serves as a vehicle. 2. On the places where the epithelial covering is easily detached, the penetration of the micrococci causes desquamation; while at those places where the epithelium is resisting and horny, there is at first formed a network, whose interstices contain at the commencement masses of the micrococci, but afterwards exudats. 3. The excretory ducts of the salivary glands, and likewise those of the lips, also serve as a channel for the introduction of the parasites, and become rapidly inflamed. 4. In the stroma of the connective tissue, the micrococci are generally diffused, but in the lymphatic spaces and in the vessels, they form circumscribed masses on their walls, and develop rapidly, producing fibrilliform clusters.

II. *Intestinal Mucous Membrane.*—This offers the same kind of alterations. In the superficial layers there is inflammation; deeper, an accumulation of micrococci, disseminated or heaped together in the vessels, which they may obliterate. An infiltration with lymphoid cells takes place in the mucosa between the Lieberkühnian crypts; whereas the submucous tissue and its blood-vessels contain abundant micrococci, which may altogether obstruct the latter.

The Cattle-plague is, therefore, in Kleb's opinion (which is founded upon a most careful histological investigation), essentially due to the proliferation of the micrococcus, which, by accumulating in the tissues, determines therein a secondary inflammation.

The micrococcus he observed is analogous to that of Small-pox; but the lesions of the epithelial system are different in the two diseases. This difference consists more especially in the absence, in Cattle-plague, of giant cells with multiple nuclei, or colonies of micrococcus; and, besides, the proliferation of the epithelial cells is less marked in Cattle-plague

are oftenest found in the jejunum or ileum. Their location corresponds to the solitary glands.

Peyer's glands submit to alterations of a particular character. They lose their epithelial covering, and, in the majority of epizoöties, undergo changes analogous to those of the solitary glands; though in other epizoöties they are rarely affected, and when they are so, the lesions are not always equally marked. Sometimes they are merely covered with a mucus layer, like the other parts of the intestine, and are injected; at other times they are more salient than usual from tumefaction, and they may then contain contents like that of the solitary glands; again, they may be covered by a croupal exudation or false membrane, several lines in thickness, and gray, yellow, red, or blue in colour, adhering by its central part to the mucous membrane. In very acute cases, it sometimes happens that these exudations join the flakes or patches on the other parts of the intestine, and form tubes of varying length; while the derm of the mucous membrane may be more or less destroyed.

The situation of these exudats is recognizable for a certain period after their elimination, by swelling, and the presence of extravasations more or less numerous, and sometimes by loss of texture. When detached, the patches are mixed with the contents of the tube, and usually accumulate towards the extremity of the small intestine, or in the large intestine. At times they become hardened, and remain for a certain period attached as crusts to the mucous membrane.

The presence of these patches is not a constant feature in the pathological anatomy of the disease; in certain epizoöties it is almost always present, while in others it is exceptional. Among the conditions which appear to have an influence in its production, only one is known, and that is the condition of the animal before infection; if it has been well nourished, these deposits are most likely to be present.

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than in Variola.—*Verhandlungen der physical. Medicin. Gesellschaft in Würsburg*, vol. iv. p. 81 (1873).

We must not omit to refer the inquirer to Dr. Beale's histological investigations in the "Report of the Royal Commission on the Cattle-plague" (1861), and also in "Disease Germs; their Real Nature" (1870).

The essential alterations in the glands of the mucous membrane appear to consist in an exaggerated proliferation of their cell-elements, accompanied by a prompt granulo-adipose destruction of the newly-formed cells.

The liver is seldom much altered, but the gall-bladder is very often distended with bile, and its mucous membrane is in somewhat the same condition as that of the intestines.

The mucous membrane of the air-passages, as has been mentioned when describing the symptoms, is profoundly altered. That lining the larynx, the trachea, and also the bronchia, is injected and marked by extravasations which, particularly in the trachea, appear in the form of longitudinal striæ. The congestion is most marked at the bifurcations of the bronchi and at the vocal cords, between the arytenoid cartilages and the epiglottis, and on the sides of the former. Œdema of the glottis is present at times. In the worst cases, the epithelium may be removed and excoriations appear. There may also be present flakes and salient patches of false membrane, of different sizes, in the bronchial tubes, and the mucous glands are prominent and enlarged. There may also be loss of substance of the mucous membrane in places.

The lungs are frequently emphysematous (interlobular), to a degree corresponding with the intensity of the malady. This condition is chiefly noticed about the borders of the lungs and in the anterior lobes, extending sometimes to the mediastinum, and passing along the large blood-vessels towards the lumbar region, it may reach the loins. The lungs are also occasionally œdematous.

The pleura, like the peritoneum, is now and again congested in places, and even ecchymosed. The pleural cavity very rarely contains any effusion.

The heart is usually flabby, dark or clay-coloured, and friable, and at times there are sub-endocardial extravasations towards its base; the blood is darker-coloured than in health, and coagulates imperfectly, or not at all.

The kidneys may be tumefied, congested, and more friable than usual. The bladder is rarely empty, but generally contains a quantity of urine which may be pale, dark-coloured,

or muddy, and have suspended in it shreds of epithelium. Its mucous membrane may also be congested and ecchymosed, and covered with viscid mucus; there are sometimes observed nodosities from the size of a pin's head to that of a pea, similar to those found in the abomasum. The membrane lining the urethra may present the same alterations.

The vulvo-vaginal mucous membrane offers a very marked redness, which generally extends to the cervix of the uterus; except at the places where the petechiæ are situated, this abnormal colour may give place to paleness. As in the mouth, so on this membrane there are little elevations of altered epithelium, with erosions covered by the viscid matter before described, when these deposits have been removed. The lining membrane of the uterus may be healthy or offer similar changes.

The udder, frequently congested, sometimes contains a small quantity of thick milk.

The nervous system does not offer anything very remarkable. There may be sub-arachnoideal effusion, cerebral œdema, and a larger amount of fluid in the ventricles than usual, with slight congestion.

NECROSCOPIC APPEARANCES IN THE SHEEP AND GOAT.

These are similar to those just described as observed in bovine animals, except that, perhaps, the lungs and pleura are more frequently inflamed. The lesions, as a whole, are less marked.

DIAGNOSIS.

The diagnosis of Cattle-plague is always of the utmost importance, as on it may depend the safety of the ruminant population of a country. Its differential characteristics are therefore deserving of the closest study. More particularly is this necessary, when it is remembered that at the initial period of the disease the external signs are negative, or but slightly marked; that the symptoms are not constant; and that if its existence is not suspected, mistakes are almost certain to occur. We will glance at some of the maladies with which it may be confounded.

1. *Aphthous Fever.*

This disease can scarcely be mistaken for Cattle-plague by any but the most inexperienced persons; nevertheless, the erosions on the gums, the abundant salivation, the difficulty in swallowing food, as well as the contagiousness of Foot-and-mouth disease, have sometimes given rise to this mistake. The characteristic vesicles, or "aphthæ," are diagnostic signs; as in Cattle-plague, the buccal mucous membrane is never affected in this manner. The excoriations remaining after rupture of these aphthæ may, however, give rise to doubts as to the nature of the malady. In Aphthous fever it may be well to remember that the aphthæ are chiefly observed on the lips, gums, the point and often the half or inferior two-thirds of the dorsum of the tongue; while in Cattle-plague the upper parts of the buccal (palate) and pharyngeal mucous membrane are the chief seat of the erosions. Besides, the characteristic epithelial alterations are not observed in Aphthous fever; while in the latter there is the localization of the disease in the feet, and the characteristic eruption on the udder and teats. The intensity of the febrile action in Cattle-plague, the alterations in the other mucous membranes, the course of the malady, and its mode of extension (for Aphthous fever is propagated more rapidly than Cattle-plague, attains its maximum of intensity within two or three days, and unless complications arise, terminates quickly in recovery), are all so many differential characters. Inoculation might, in certain cases, facilitate the diagnosis by allowing the early symptoms of the doubtful disease to be studied, but such a necessity can seldom arise. The examination of the body of an animal which has died or been killed, should also decide the question.

2. *Contagious Pleuro-pneumonia.*

This malady, at a certain stage, might offer a few analogies to those cases of Cattle-plague in which the pulmonary symptoms are very developed. The alterations in the mucous membrane in Cattle-plague, the increased respiratory murmur or

râle on auscultation, the absence of dulness on percussion, and the mode of propagation of the disease, should readily distinguish the two affections.

Even should Cattle-plague attack an animal affected with pulmonary hepatization, the characteristic lesions of the mucous membranes—buccal and intestinal—in the former disease cannot be mistaken.

3. *Diarrhœa.*

(Acute Intestinal Catarrh.) This differs from Cattle-plague by its being non-contagious, and in its causes, its exclusive localization in the intestinal mucous membrane, the absence of systemic fever and disturbance in the other mucous membranes, its course, necroscopic lesions, and the generally favourable results of treatment.

The enteritic Diarrhœa of sheep, and particularly of lambs, bears some slight resemblance to, but should not be confounded with, Cattle-plague. The early and constant appearance of Diarrhœa, which is generally the principal and only symptom, and the mouth, which, instead of being foamy and red as in Cattle-plague, is dry and white, and the eye also white, should establish an easy diagnosis during life. And after death no alteration is perceptible in the respiratory mucous membrane.

4. *Dysentery.*

The prominent symptoms of Dysentery are the prompt appearance of profuse and fœtid Diarrhœa, becoming rapidly sanguinolent; while in Cattle-plague the less intense Diarrhœa rarely appears before the third day, and the fæces are neither so sanguinolent nor mixed with the characteristic *débris*. In Dysentry, the bucco-pharyngeal mucous membrane is not altered in the same manner as in Cattle-plague; if any epithelial lesions are present they do not appear on the pharynx, neither does the epithelium offer the same histological changes. The alteration in the digestive mucous membrane throughout its substance, and its evident inflammatory softening, should be considered as the characteristic lesions of Dysentery, and these are always

absent in Cattle-plague. In the latter is constantly found a specific alteration of the surface of the mucous membrane, accompanied by certain marked changes in the elements of this part, which are never witnessed in Dysentery. Besides, the latter malady is generally directly caused by chills, intense heat, humidity, fatigue, &c., and contagion has nothing to do with its genesis. The progress of Dysentery, too, is irregular; several animals may become affected at once, and the disease may then disappear, to reappear, perhaps, after several weeks.

5. *Malignant Catarrhal Fever.*

Cattle are in some countries attacked with a serious form of Catarrhal fever, which, in some of its features, resembles Cattle-plague. The intense febrile re-action, the alterations in the mucous membranes of the head, and the constipation followed by diarrhœa, are the phenomena which might give rise to error in the early days of the disease. The opacity of the cornea which soon appears in this malady, the difficult and sonorous respiration heard from the commencement, the heat of the head, the intense redness of the pituitary membrane and the copious discharge from it, as well as the absence of the pathognomonic signs of the Cattle-plague, should readily distinguish this from the latter malady.

In this form of Catarrhal-fever, there are also found in examining the dead body, yellow gelatinous or pseudo-membranous exudats on the mucous-membrane of the nasal cavities and sinuses; but these bear no resemblance to the characteristic patches in Cattle-plague, neither are there any of the alterations we have described in the abomasum or intestine.

6. *Variola or Vaccinia.*

There is no analogy between Cattle-plague and this exanthematous disease; for not only are the cutaneous eruptions very different, but in Vaccinia none of the essential and characteristic lesions of the plague, as manifested on the mucous membranes, are observed; and the course and gravity, considered in a general manner, are far from being the same in the

two affections. Inoculation also proves that they are essentially different.

7. *Rabies.*

The nervous excitement in some forms of the Cattle-plague may bear a certain resemblance to that frequently observed in Rabies; the fits of delirium that sometimes ensue at the commencement of the plague, as well as the great apathy, prostration, and staggering gait are not unlike what is noticed in cattle at a certain stage of Rabies. But the resemblance is very superficial; the specific alterations in the mucous membranes are absent, as well as the internal lesions which we have indicated as peculiar to the Cattle-plague.

8. *Anthrax.*

In those countries in which the different forms of Anthrax prevail, there not unfrequently exists a similarity between its manifestations and those of Cattle-plague which might embarrass those who are inexperienced in the two maladies. More particularly is this the case in that form of Anthrax which has no external localization in the shape of tumours or carbuncles; and it is only by a correct knowledge of the symptoms in both diseases, a most careful necroscopical examination, and taking into consideration the morbigenous causes, and the extraordinary rapidity with which Anthrax runs its course, that a correct diagnosis can be established. In ruminants, this form of Anthrax is announced by stupor which may become immobility, though great excitement may at times mark the commencement of the disease; the temperature of the body frequently varies, but the extremities are generally cold; the respiration is quickened, short, and sometimes sonorous; the pulse is accelerated, and oftentimes almost imperceptible; the mucous membranes look highly inflamed and yellowish, and are often the seat of petechiæ, blood-staining, and at times of yellow, gelatinous, or sanguinolent infiltrations; the muffle is dry, and grinding of the teeth is frequently heard; the appetite and rumination are usually suppressed, but the thirst is rarely increased; the fæces are

dark-coloured, and in the majority of cases mixed with blood, and blood may flow from the nose and mouth. Symptoms of Colic may likewise be exhibited ; the secretion of milk is also diminished, and sometimes that fluid is altered in quality. At the necropsy of animals which have succumbed to this affection, it is noted that the majority of the organs, and particularly the lungs, are gorged with a black, viscid, pitch-like blood ; that the spleen is enlarged and the mesenteric glands infiltrated ; that extravasations of blood have taken place in the intestinal canal, the serous membranes, between the muscles, and into the subcutaneous cellular tissue ; that very frequently the yellow and sometimes sanguinolent gelatinous exudats are formed at the origin of the large blood-vessels and near the root of the lungs, as well as in the connective and parenchymatous tissues ; and that in those instances in which death had not taken place so rapidly as usual, the agminated glands of the intestines are tumefied, sometimes ulcerated.

There is no epithelial proliferation on the buccal, nasal, vaginal, or intestinal mucous membrane, as in Cattle-plague, nor yet have we the erosions of Kausch, and Peyer's patches are not covered by the pseudo-membranous deposits as in the latter malady ; while the tendency to general formation of viscid gelatinous masses of a red, brown or black colour in all the organs and tissues, the enlargement and softening of the spleen, and the pitchy consistency and hue of the blood, should easily serve to distinguish Anthrax from the bovine plague. If external tumours are present in the form of carbuncles, then the diagnosis is greatly facilitated. Both maladies are contagious, but the virus of Cattle-plague is by far the most certain in transmission. This abdominal Anthrax, as it has been termed, arises spontaneously in our regions ; Cattle-plague is exotic, and only appears as an importation.

As an aid in establishing a correct diagnosis, of course every means should be resorted to in order to determine how the disease has been introduced—how the transmission of the contagium has been effected. This inquiry is in some cases easily and satisfactorily accomplished ; in others it is sur-

rounded with great difficulties, particularly at the commencement of the disease in a country. The malady is usually introduced by strange cattle, and we have already observed that certain breeds have the disease in such a benignant form, and recover so easily, as to escape detection under ordinary circumstances. Not only is this the case, but animals which have recovered may yet be the carriers of the virus, which may remain attached to their hair; so that others in the droves which have not yet had the disease may become contaminated, and in this way the malady may continue to appear in the same herd for some time after it has left its native country. Consideration must also be made for the deception and craftiness practised by cattle-dealers and drovers in their endeavours to dispose of diseased animals, no less than for the cupidity and ignorance of the inhabitants of the districts in which the malady makes its appearance. The contagium may also be introduced by various media than living cattle or other ruminants.

As we have said, it is all-important to discover and diagnose the disease at its commencement in a country, as radical measures may then be successfully adopted to prevent its extension and assure its prompt extinction. For this reason, the veterinarian should be able to distinguish it during any stage of its development.

At the commencement, as has been mentioned, it is most difficult to diagnose, more especially if the existence of the malady is not suspected in the district, and the expert is called upon to pronounce as to the nature of the malady affecting those first seized. And even when the disease does prevail extensively, the general symptoms by which it at first reveals its presence are not at all dissimilar to those pertaining to other bovine maladies. Therefore it is that, in countries where the disease frequently appears, the most experienced veterinarians attach only a relative value to the presumption that Cattle-plague is present and to the symptomatology; relying chiefly, if not solely, on the morbid changes that occur early in the disease to enlighten them as to its nature.

It is all-important, then, when the disease cannot be cer-

tainly detected at its commencement during the life of the animals, that one or more should be killed in order that a careful examination be made of the various organs which furnish pathognomonic signs of the plague. An inspection of the mucous membrane lining the digestive apparatus will dispel all uncertainty that may exist as to the nature of the malady, and confirm or invalidate the conclusions drawn from the symptoms observed in the living animals.

At a more advanced period—say the second, third, or fourth day—a close inspection of the visible mucous membranes, especially those of the mouth, will furnish a most useful aid, and, taken in conjunction with the other symptoms, should leave little, if any, doubt as to the character of the affection. When fully developed, the symptoms are, as a rule, so characteristic that a mistake is scarcely possible, except in Steppe cattle, in which the signs of illness are often so vague and ill-defined that the most expert veterinary surgeons sometimes hesitate in giving an opinion.

When the malady commences with violent symptoms, or has reached its last stage, there should scarcely be any difficulty in diagnosing it. The symptoms may vary in their mode of manifestation and order of succession, and some may predominate over others; but the characteristic features of the disease are always more or less apparent, and cannot be mistaken by the veterinary surgeon.

CONTAGIUM.

The virulent principle of Cattle-plague is developed in every animal affected with the disease from the commencement of the symptoms, or, at least, as soon as the secretions or excretions begin to be increased; and in these it appears to be most concentrated, though all the tissues and fluids in the body are charged with it. It is produced during the whole course of the disease, and the textures and fluids of the dead body largely contain it. With convalescence its production ceases, and in cases in which animals in this stage have transmitted the affection to others, it has been owing to the virus

previously generated remaining attached to the surface of the body, hairs, crusts, &c.

There can be no Cattle-plague without this virulent agent, which, for convenience sake, we will agree to discuss as existing in two forms—*fixed* and *volatile*. In what we will suppose to be its "fixed" state, it is present in all the fluids of the body, and the flesh, skin, horns, hoofs, and excrements, and may attach itself to the litter, manure, utensils which have been in contact with the sick, the clothes of those persons who have been near them, as well as to other animals, &c. In the "volatile" condition, it is carried by the breath, cutaneous emanations, vapour of the blood, &c.; and, in fact, the fixed state may become the volatile, and *vice versâ*: the virulent matter being the same in both, and when disengaged from the sick animal or its *ejecta*, the air around it for some distance may become contagiferous, and, penetrating porous bodies, give these the property of communicating the malady.

VITALITY OF THE VIRUS.

The vitality of the virus has been referred to in the second section of this work. It may only now be necessary to state that, in certain circumstances, it may retain its activity for a long time if preserved from contact with the atmosphere and a high temperature. Various conditions influence this tenacity, but some of these are unknown, and the most varied results have been obtained by experimenting with the contagious matter, or rather its vehicles.

Sometimes the virus, though only a few days old, has been found quite inefficacious; while at others it has been successfully inoculated after being kept for months, or even more than a year. In Belgium, in 1868, Cattle-plague re-appeared in two localities in the province of Antwerp, eight months after the last cases had been observed.

The air appears to rapidly destroy the activity of the virus, whether it be in a fixed or volatile state; though to do so it must be frequently renewed. Kept in carefully-closed capillary tubes, it will retain its power for a long period, or, contained among closely-packed hay, it may remain potent for

months. Salchow gives an instance in which the disease appeared after the use of hay that had lain in an infected stable for a year;* and the remains of carcasses (skin, flesh, &c.) buried for thirty days, and even three months, have preserved their contagiferous properties. How the air destroys the infecting power of the contagium is not exactly known; it may be by accelerating chemical changes in it, or by diffusing or diluting its particles to such a degree as to render them inert.

It is certain that the air can also carry the infecting element to a certain distance, as has been already shown.

A low temperature is favourable to its preservation, as frost does not destroy it; and the heat of summer only hastens its destruction, but does not annihilate it; though when the virus has been heated to 131°, and healthy animals inoculated with it, the malady has not been produced.

A certain degree of humidity is necessary for its preservation, and it has long been observed that a damp atmosphere favours the propagation of Cattle-plague.

The influence exercised by putrefaction on the vitality of the virus has been variously stated. Animal matter charged with it, after having been buried for two years and three months, did not produce the disease; though Vicq d'Azyr states that he successfully inoculated with the remains of cattle which had been interred for three months.

Disinfectants have a more or less powerful effect in diminishing or altogether destroying the properties of the virus; chlorine, ozone, sulphurous acid, the tar acids, &c., are noted for this quality.

INFECTION.

Animals may become affected with Cattle-plague naturally (by accidental contact with diseased creatures, or vehicles carrying the contagium), or artificially (as by inoculation). The intensity of the disease depends upon the quality of the virus and the predisposition of the animals.

* Müller cites an outbreak due to giving hay which was contaminated five months before.

With regard to the predisposition of species and breed, we have given some examples in the first section. So far as species is concerned, the action of the virus is much less intense in the ovine and caprine than in the bovine species, contact of these with the latter when diseased only producing a minimum number of infections. By natural infection, it has been observed that only 20 per cent. have been attacked, while experimental inoculation has raised this number to 50 per cent. In some rare instances the contamination is even 70 per cent. In the north-west provinces of India the proportion of attacked is 60 per cent. The virus of diseased sheep or goats is as potent in infecting cattle as if transmitted from the bovine species. The Steppe, and particularly the Kirghis, cattle, as well as those of Hungary, are less susceptible than other breeds.

With regard to individual predisposition, we have already stated all that is known. It is certain that every bovine or ovine animal does not become infected, though exposed to the same exciting cause as those which are diseased.*

The hygiènic and dietetic conditions to which animals are submitted, have, to a certain extent, an influence in rendering them susceptible to the infection, as well as in modifying the course and result of the disease. But this will be alluded to presently.

Temperature has also an influence on the intensity of the

* Deer are susceptible to Cattle-plague infection, as are also buffaloes. In Egypt, the latter have perished by thousands during an epizoöty of this disease; and while it raged among cattle at Hong Kong, China, during my stay there in 1860, Sir W. Schomburgh, H.M.'s Consul at Bangkok, reported a most destructive murrain among the domestic buffaloes in that country.

In 1861, while the Cattle-plague raged in Egypt, it carried off an immense number of camels; consequently, the charges for transport rose in 1864 and 1865 to a rate that completely paralyzed the trade of Upper Egypt (*Baker*—"The Nile Tributaries of Abyssinia," p. 18).

In India, the malady has been observed to affect bullocks, buffaloes, yaks, jooboos, goats, sheep, and deer. It is stated in the Report of the Indian Cattle-plague Commission, published in 1872 or 1873, that "the evidence is strong as regards pigs, but we failed to induce the disease in them by inoculation" (page xxviii.).

action of the virus; it has been observed that inoculations made in a cold season aggravated the symptoms of the artificial disease, as did also intemperate weather.

With regard to age, it would appear that young and old animals are more severely affected, and in larger proportion, than those of middle age.

The virus does not seem to be mitigated in intensity by repeated transmissions or culture: after fifteen generations it will induce as serious disturbance as it did at first. Neither does dilution modify its effects, except that, if carried too far, it renders it inert. It has been remarked, however, that while virus in a fresh state, or nearly so, will induce a violent form of Cattle-plague, that which has been kept for a long time will only produce mild symptoms, or have no effect. The experiments which have established this fact, it is necessary to remark, were conducted in Russia.

MODE OF INFECTION.

Infection may be *direct*, the contagium being conveyed from an animal suffering from Cattle-plague to another which is healthy, but capable of receiving it; or *indirect*, through the medium of a foreign body containing the contagium. Direct infection, by means of an atmosphere tainted by a diseased animal or its carcass, is generally considered as contagion by *direct* or *immediate transmission*.

Direct infection is the most palpable and convincing mode of propagation, and there are so many facts to prove that the air for a certain distance from the pest-stricken animal will communicate the disease, that all doubt with regard to this must be considered at an end.

Indirect or "mediate infection" occurs in many ways—in fact, almost everything in the form of solids or fluids which have been in contact with diseased animals, or their secretions or excretions,* may become a carrier of the virus. Sometimes

* After the manure and litter, forage is the most likely source of infection, and there are several striking instances on record of the disease being conveyed by this article a long time after it had become contaminated. Haubner alludes to an outbreak due to trusses of hay which were given to cattle four months after they had been removed from an infected stable.

it is the remains of the dead cattle, and at other times it is living creatures which convey it; while in many instances inert bodies retain and transmit it, preserving it as long as the conditions in which they are placed are favourable to its vitality. Porous bodies and masses of materials in which the air cannot circulate freely, such as trusses of hay, or bundles of straw, manure,* woollen stuffs, &c., retain it longest. The virus may also be conveyed from one substance to another several times without losing its contagious property. The more easy the communications with the sick, the greater are the chances of transmission by these different media.

Among the agents which may serve for the conveyance of the contagium, may be enumerated, in the first place, the remains of animals which have perished from, or been destroyed in consequence of, Cattle-plague—such as the flesh,† skins,‡

* The manure from sick animals has long been recognized as a most potent agent in diffusing the contagium, and it would appear to preserve its virulent properties for several months.

† The instances in which Cattle-plague has been propagated by the flesh of diseased animals are very numerous. The recent war in France, and the coincident appearance of the disease in many localities, compelled the people to use this flesh as food, and several outbreaks are traced to this traffic. In England in 1865-66, there can be no doubt that the very reprehensible practice of disposing of sick cattle surreptitiously to the butchers, served to propagate and maintain the pestilence; and in the Austro-Prussian campaign, as well as during the Danish war, the utilization of this flesh frequently carried the contagion into new localities. Bruckmüller mentions that some soldiers washed the flesh of diseased animals in an arm of the Leitha. A cow and calf drank of the water a short distance below the place, and soon after were attacked with the plague. Two other animals which refused to drink remained healthy. Dressler witnessed two oxen which had been employed to transport the flesh of affected cattle, suffering from the malady a few days subsequently. And Gerlach cites another instance in which a farmer had his stock infected by their drinking the water that had served to wash the head of a cow that had been killed, owing to its being affected with this disease.

‡ Fresh hides were known to infect in the last century, and abundant evidence of their potency in this respect has been obtained in this. The Russian Commission on the disease, after a number of experiments, came to the conclusion (published in their report in 1866): 1. That fresh or incompletely dried skins, which have not been disinfected, may infect

viscera, &c., which are frequently carried considerable distances from the infected locality.

Everything contaminated by the diseased animals may retain the virus and communicate the malady. Birds, such as pigeons, have been suspected, and not without reason, of carrying it; and rats, dogs, and hares have also been accused.*

A crowd of circumstances varies the limits and mode of infection. More especially is this the case with the contagium in a volatile form; for in this condition the thermometric and hygroscopic condition of the air will modify more or less the radius of diffusion, as will also the direction and force of the winds, topographical situation, the malignity or benignity of the malady, the duration of the epizoöty, the intensity of the contagion in a disease focus, the breed of cattle infected, the conditions in which they are placed, &c. In India, observations led to the belief that a distance of thirty yards was sufficient to afford security from infection.

MODE OF ACCESS.

The contagium may obtain access to the blood through several channels, but the most common in natural infection is undoubtedly by the air-passages during the function of respiration; we have no very substantial experimental proof that the digestive organs afford ready access, though there are many facts and observations which tend to prove that accidental infection may occur through this apparatus. The skin deprived of its epidermis is a ready channel for the admission of the virus; and the malady is most certainly and promptly produced by inoculation, injection, or by setons beneath the skin.

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healthy cattle; 2. That not only contaminated skins which have been submitted to artificial purification by lime-wash, a high and dry temperature, and boiling water, but also those which have been well dried in the open air, will not produce the disease either in the Orenbourg or Khersonese Steppes. In India, the traffic in hides and the sale of the flesh of diseased animals are justly regarded as aiding largely in the diffusion of the disease.

* Bruckmüller gives an instance in which it was very probable that these creatures were instrumental in diffusing the disease.—See the *Oesterreich Vierteljahress.* 1867, p. 43.

INCUBATION.

From the moment an animal has received the infection, either naturally or artificially, until the manifestation of the characteristic primary symptoms, there is an interval—the *period of incubation*—which varies somewhat, but is, nevertheless, to a certain extent, pathognomic of the disease. Ordinarily this latent period, during which the animals appear as healthy as usual, is five or six days; observations continuously and perseveringly carried on in Russia for a period of ten years, have yielded this result; which has otherwise been confirmed by many competent veterinarians for a long time. Exceptionally, this interval may be longer or shorter: eleven, twelve, and fifteen days have been given for some cases, and twenty-one and twenty-six days in others; even five to eight weeks have been mentioned, but in all likelihood there was some error of observation in these.

Different observers have given different periods. Haubner gives from six to seven days; Hekmeyer fifteen, sixteen, and even twenty days; Müller, seven days; Fürstenberg, fourteen to eighteen days; Defays and Wehenkel, from fifteen to eighteen days; and Leisering from fourteen to sixteen days. In England, in 1866, from four to nine days was generally noted. However much the period of incubation may vary according to circumstances, there yet appears to be a wonderful unanimity among the most competent veterinarians as to its not exceeding the tenth day. At the International Veterinary Congress held at Hamburg in 1863, at Vienna in 1865, and at Zurich in 1867, this period was almost unanimously adopted as the basis of a quarantine regulation.

Some authorities are of opinion that the period is longer in cases of natural infection than in those produced artificially; but as it is not always an easy matter to determine when natural infection takes place, there may be doubts as to the correctness of this opinion, especially if the disease has been prevalent for some time.

In giving the above period, of course the appearance of the

more palpable external symptoms are alluded to; but if we take into consideration the thermometrical evidence, then we must reduce the latency of the malady by one or more days; for, as has been already stated, an elevation of temperature may be noted thirty-six to forty-eight hours after infection, and two days before any other disturbance is observed.

In *sheep* infected in the natural way, the incubatory period varies from four to nine days; by inoculation, from two to six days. It may be observed that when the disease is transmitted by natural infection from the sheep to the ox, this latent stage lasts from four to eight days; but if by inoculation, from three to four days.

EXTENSION.

Few, if any, of the contagious diseases which affect animals spread more rapidly and steadily than Cattle-plague, and perhaps there is none attended by so great a mortality.

The period of incubation first impresses on the development of the disease its "jerking" (if we may use the term) mode of propagation in a stable or locality into which a contaminated animal has been introduced.

A few days after this creature has sickened, those which are nearest to it are first attacked; then those in the vicinity of the latter, and so on, the malady being propagated from animal to animal; so that, by starts at first, the plague progresses, every creature infected becomes a fresh centre, and an additional laboratory for the indefinite multiplication of the virus; and in a brief period, a large herd, a district, a county, a province, a kingdom, or an entire continent may be ravaged by the disease.

The regularity of propagation just alluded to is not always the rule, for the contagion may reach animals a considerable distance from the disease, if transmitted by persons or substances which have been in contact with the latter; neither is it so regular if the animals are at pasture or in droves, because of the multiplicity and frequency of contact; for the more the communications are multiplied and the animals are numerous, so do the cases occur more frequently, and the

greater is the irregularity in its mode of propagation.* The habitations and the markets the diseased cattle have frequented, the railways, vessels, and roads they have travelled by, the pastures they have grazed upon—all become so many foci, from each of which the pestilence may radiate in every direction.

All these favour the diffusion of Cattle-plague, but other circumstances lend their influence also; for instance, the people who deal in cattle, or have to do with them, such as dealers, drovers, butchers, tanners, empirical cattle-doctors, as well as the people of the infected localities communicating with those which are yet free from the disease, the common pastures, attending to the sick and healthy by the same persons, the unrestricted movement of cattle and other animals, giving food or drink to healthy cattle which has been contaminated by the diseased, &c.

The history of the disease teems with illustrations of the rapidity with which it spreads when circumstances are favourable. One or two of the more recent may be alluded to. In the outbreak in Thuringia and Franconia, in 1867, the first case was observed in the beginning of April, and by the end of May 135 farms in forty places were infected, the total loss amounting to 791 cattle, 11 sheep, and 29 goats. In Upper Silesia, in a recent invasion, the earliest case was noted in the middle of September, and in two months 127 farms in thirty-six villages were involved, the loss amounting to 1077 head.

In England, in 1865, the disease was introduced in June; it was first ascertained to exist in London on the 24th. In October following, it was calculated that 17,000 head had been infected, and that the disease was destroying the cattle

* The examples in illustration of this are innumerable. We will select one from the most recent. According to the *Veterinarian* (October, 1873, p. 695), on Saturday, July 27th, 1872, about a score of Russian cattle affected with Cattle-plague were in the Humber Dock (Hull), a few hundred paces from the cattle-market. On Monday, July 29th, cattle bought in that market were moved to Patrington and Bridlington; in the places to which these animals were taken, Cattle-plague appeared, and it subsequently extended to other districts.

of twenty-nine counties in England, two in Wales, and sixteen in Scotland. In November only four counties in England were exempt, and the malady was present in nineteen of the thirty-three Scotch counties. Up to December 30, the number of animals attacked was 73,549; on the 27th of January it was 120,740; in February, 13,113 cases occurred in one week; and in March it had reached the extraordinary figure of 187,000; though there can be no doubt whatever that this is far from representing the actual number. Owing at first to an absence of any kind of sanitary organization, ignorance of the public as to the nature of the disease, and latterly (previous to March) of an inefficient system of suppression, the contagion was allowed to spread as it might. We are thus presented with an excellent (but deplorable) example of the manner in which a contagion may become indefinitely multiplied, in the absence of any effort to limit its extension.

Holland also affords another melancholy, but instructive, instance. As deficient in sanitary organization, and as ignorant of a knowledge of the power of the contagium as England, the disease was carried to that country from our own, and at the end of August sixty cases had been noted in twelve localities; towards the end of November it existed in eighty-three places, and 1000 head of cattle were affected. In the following three months it may be said to have invaded the whole country; as many as 7700 were infected in one week, and the loss (approximate) was very great, 115,000 alone being killed.

As has been mentioned, the disease is not so readily transmissible among other ruminants, and does not, therefore, extend so rapidly.*

* Nevertheless, at times it appears to spread with rapidity and violence. In 1860, the malady was imported into the Island of Chusan by the cattle from Hong-Kong which accompanied the expedition sent to capture that place, prior to commencing operations in the North of China. A few months afterwards, the mortality among the sheep and goats was very great over the whole island; and one ship sent from the North to Chusan for a cargo of these animals, returned with only a few out of many hundreds embarked, the others having died in transit. The Catarrhal symptoms were very marked; there was Diarrhœa, and the buccal erosions were most evident in the advanced cases.

MORTALITY AND LOSS.

The mortality varies not only with the race, but in different epizoöties; there is also good reason for believing that hygiènic and other conditions influence the death-rate considerably.

With regard to race, it appears to be ascertained that among the Steppe cattle the mortality is from 30 to 50 per cent., and on rare occasions as low as 10 per cent. Among the Hungarian breed, the per-centage of recoveries is also, as a rule, comparatively large, not unfrequently one-half the number attacked surviving.

In the Bukowine (Austria), according to Röll, the deaths have been 67, in Moravia 90, Bohemia 98·7, and in Styria 100 per cent.

The same authority mentions that, in 1860-61, in the 27 districts of Austria, containing 157,800 head of cattle, 15,930 were attacked, and 4800 died. In the county of Presbourg, in a bovine population of 35,566, 6773 sickened, 5630 perished, and 1436 were killed. In Great Britain, during 1865-66, 279,023 were reported sick; of these 233,629 died and were killed, and 40,165 recovered. In Holland, for the same period, the number attacked was 156,592; 78,111 died, and 36,919 were killed, while 51,562 recovered.

In the North-West Provinces of India, the proportion of attacked is 60 per cent., that of recoveries 20 per cent., and deaths 40 per cent.

It may be said that, in general, with Western cattle, the mortality is very great, the recoveries seldom averaging more than five to ten per cent.

In the various invasions, the number of recoveries differ very much. This is well demonstrated in the history of the disease. The last century irruptions into Holland, for instance, were marked by a great destruction, very few animals surviving; whereas, in 1865-66, notwithstanding the almost total absence of all check to its progress at first, the recoveries were 33 per cent., though it must be remarked that 50 per cent. of the diseased or suspected were killed, the remainder dying.*

* The terrible losses inflicted by this disease in Europe alone, at its

It would appear that animals living in a state of nature withstand the plague much better than those artificially reared,

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several invasions, form a most interesting, if deplorable, chapter in the history of contagious animal maladies. In the last century, the destruction of cattle was perfectly appalling. Faust estimated the loss in Europe, from 1711 to 1796 included, at 200,000,000. And in this century the disease has not been less severe; though its opportunities for extension, much greater than before, have been largely checked by veterinary science. France, in 1815, suffered heavily during the presence of the Allies on her soil. Egypt lost, from 1841 to 1844, 400,000 head of cattle; and in 1844 and 1845, 1,000,000 head perished in Russia. From 1849 to 1863, the Austrian States lost 258,107.

In Hungary, in the six years from 1861 to 1867, the disease broke out in 680 communities, having an aggregate of 908,209 head of cattle; of these, 25 per cent. were attacked, and 145,474, or 63·9 per cent., died or were killed. From the middle of 1867 till the end of 1873, it appeared in 430 communities, having 425,922 head of cattle, of which 7·8 per cent. were affected; 20,258, or 60 per cent., died or were killed. Calculating the value of the animals at only £5 in the first six years, Hungary lost through the Cattle-disease £727,370, while in the last it only lost £101,285. The supposition that the disease within the last six years had shown itself in a milder form than in the six years before is altogether excluded, as the rate of mortality is only a trifle smaller—60 instead of 63 per cent. This favourable result, within the last six years, has been obtained at a cost of about £3,000 more than was yearly spent before.

In Russia, in 1860, the number was 183,678; and it has been estimated that England lost, in 1865-66, 233,629 head, though this is doubtless below the actual number. Holland at the same time lost 115,000. The destruction of cattle in France during the late war must have been very heavy.

The losses caused by the disease in Germany, in 1870, have been published in the official report which the Chancellor of the Empire, Prince Bismarck, presented at the third session of the Reichstag. This report, however, does not include the losses among the cattle of the army commissariat parks, which must have been enormous.

PRUSSIA.—Government of	Berlin	118 head.
„ „	Potsdam	621 „
„ „	Frankfort-on-Oder	28 „
„ „	Stralsund	340 „
KINGDOM OF SAXONY		212 „
GRAND DUCHY OF MECKLENBURG-SCHWERIN		205 „
PRUSSIA.—Government of	Coblenz	1875 „

and kept, as our finer breeds of cattle are. Good and abundant food, a healthy atmosphere, and sufficient protection from the action of external influences, are favourable to recovery; while the opposite conditions militate against it. Bad

PRUSSIA.—Government of Wiesbaden . . .	39 head.
„ „ Trèves	3227 „
GRAND DUCHY OF OLDENBURG	246 „
PRUSSIA.—Government of Cologne	348 „
„ „ Düsseldorf	169 „
GRAND DUCHY OF HESSE	44 „
Total	7472 head.

If to these be added some isolated outbreaks at the end of 1870 and commencement of 1871, and which really belong to the principal invasion, there is a total loss of 8122 head in 230 localities. Of these animals, 921 died, 2610 were killed as diseased, and 4484 as suspected. The losses sustained in the army during the war in France are unknown; but the commissariat contractors lost in Germany alone 2104 head. There is no mention of the sheep which perished, though the number is believed to be considerable.

The losses occasioned by the same disease in Alsace-Lorraine were still more severe; for in the department of the Bas-Rhin only, the official report gives it as 6104 cattle and 160 sheep for 1870-71—the period corresponding to the invasion of the German troops—and 582 cattle and 944 sheep for the second period—when the same troops returned. The amount of indemnity for cattle destroyed was 1,622,249 francs. Zundel believes that for the other two departments of the annexed territory—Lorraine and the Haut-Rhin—the loss is also very great; in the first, he reckons that 5000 cattle and more than 3000 sheep, and in the second 1400 cattle, perished. The indemnity to cover this loss is estimated at one million and a half francs.

In August, 1873, 13 governments in Russia were invaded by the disease; and it was estimated that 18,000 animals were affected, 14,000 of which died or were destroyed.

These are only a few of the outbreaks of the disease, and afford but a feeble, though striking, illustration of the havoc caused by this bovine scourge. It is impossible to estimate the total loss in animals. And even could such an estimate be obtained, it would then not represent all the damage done; no one can form any conception of the material losses resulting from the impediments the disease throws in the way of commerce, the trade in cattle and their products, the expense of organizations to suppress the disease, the check to agriculture, the enhanced price of animal food, and the efforts to compensate for its scarcity and dearness.

food and faulty stables have a very pernicious effect on the vital resistance of animals.

It is the same with sheep. Weakly animals, as well as those which are lodged in small, hot, and damp buildings, or which are exposed to unfavourable atmospherical influences, succumb more frequently to the disease than others. The mortality may reach 20 to 40 per cent., whereas with proper management it may be only six to ten.

In some epizoöties, the mortality is greatest at the commencement, and less towards the end, the number of deaths gradually diminishing. But this is not always so, nor is it even the rule. History shows that, comparatively mild at first, many epizoöties are undiminished in their virulency and mortality after two or more years' prevalence. From the evidence afforded by past experience, it does not appear that the virulency of the contagium is at all modified or mitigated by successive transmissions.

In the ovine and caprine species, the mortality also varies; but as yet we have not a sufficient amount of data wherewith to found any satisfactory conclusions. It is certainly much less than that of bovine animals, as experience has shown. For example, during the epizoöty in Austria in 1863, according to Röll, only 7·8 per cent. of the cattle recovered in Carniola, 5·7 in the government of Trieste, and 16·8 in the province of the military frontiers; while of the sheep attacked, 39·5 recovered in Carniola, 30·5 in Trieste (littoral), and 27·7 in the military frontiers. At times, however, this rate of mortality is greatly exceeded. In Poland, in the same year, there were only 20·8 recoveries; and in the Hungarian Comitat of Gömörer scarcely any survived. In four localities of Galicia, in 1864, during the prevalence of the Cattle-plague, the survivals among the sheep affected were but three per cent.

IMMUNITY.

An attack of Cattle-plague confers immunity from the disease for the remainder of the animal's life; or at least for a lengthened period, which, according to the experiments and observations made in Russia, is not less than six years. The

animals susceptible of the malady are seldom permitted to exist for a longer time; it is, therefore, not possible to state, positively, whether a second infection might not take place. The probability is that it would not. It may be added, however, that it is the universal belief among the natives of India, that one attack affords protection for life; and a practical proof of this is evidenced by the enhanced value of *Māntuar* bullocks (animals which have had Cattle-plague—*Mān* in the Kumaon). The Indian Commission gives an instance in which three of these bullocks, which had been affected ten years previously, proved refractory to infection.

SANITARY MEASURES.

An intimate knowledge of the disease, and of the nature of the contagium upon which its propagation depends, must form the basis of all sanitary police measures; while the judiciousness of these measures, and the prudence and vigour with which they are carried into effect, can only be relied upon to preserve countries from its ravages, either by preventing its admission, or arresting its spread should it obtain an entrance.

Sanitary measures have therefore, for their object: (1) To prevent the introduction of Cattle-plague into a country; (2) To check, without delay, its propagation when it has gained admission, by destroying the virus in or upon everything which may be charged with it, or carry it. These measures—which we may designate "Permanent Precautionary Measures" and "Provisional Measures"—may vary in details in different countries exposed to the invasion of the malady; though in their principal features they may, and indeed must, be essentially the same. The best devised measures are more or less applicable to all countries, and may be appropriately sketched as follows:

PREVENTIVE MEASURES.

PERMANENT PRECAUTIONARY MEASURES AGAINST INVASION.

These measures are instituted with a view to prevent the introduction of the disease from suspected countries in which it is always more or less present, or into which it may have been imported, and from which there is danger of receiving the infection. In this country, and the other western regions of Europe also, Russia and the Danubian Principalities should be, with regard to sanitary measures, reckoned as "always suspected," and precautions taken accordingly. The routes by which diseased cattle may arrive should be well-known, and particularly those which lead from the regions in which the disease is always more or less prevalent. These should be scrupulously watched.

With regard to other countries which may become infected, it must be remarked that the nation which seeks to preserve itself from the disease should always endeavour to obtain the earliest information of the outbreak of any suspicious malady among the cattle of the different states with which it may traffic; this information should be furnished without delay by the consuls, ministers, or other officials belonging to that nation, and who ought to be furnished with instructions to this effect. And states so invaded should be under an obligation to warn those with which they have commercial dealings in animals or their products, of the existence of any disease of a contagious or suspicious nature. The limitation, suppression, and final extinction of contagious animal diseases should be regarded by every government as a great work to be accomplished in the general interests of civilization and humanity; and the rulers of a country in which a malady of this kind has appeared, ought to consider it an imperative duty to prevent, as far as they possibly can, the extension of the disease.

The traffic in cattle is every year assuming greater proportions, and England, France, and Germany are compelled to

seek their supplies in regions more remote and perilous than formerly. Railways and steamships have very considerably abridged time and space; so that the danger of importing animals direct from the suspected countries is ever on the increase. It is true that some of the routes by which cattle from these countries must travel to reach Britain, pass through states which have a most efficient sanitary organization, and are not likely to allow diseased animals to enter their territories; or if, by chance, these do evade the frontier scrutiny, that they will promptly annihilate the contagion. But it is also true that we may receive, and have received, infected cattle direct from the disease-centres without this safeguard being available—as from the Baltic ports.

It is therefore most important that not only the countries should be known from which supplies of animals are derived, as well as the sanitary condition of these countries with regard to contagious diseases; but also that the routes by which the animals arrive should be accurately defined and understood, as well as the time occupied in transit.

Certificates of health from inspectors at the points of departure are not always trustworthy; as animals which may be apparently quite well when inspected, previous to commencing their railway or sea journey, might yet be infected, and the disease only develop itself in transit, or even after arrival in this country: this depending on the date of infection and the period of incubation.

It is scarcely necessary to say that the certificates of none but competent and responsible veterinarians should be received.

The permanent precautionary measures to be adopted in the country which seeks to protect itself from Cattle-plague, have already been alluded to in a general manner in the second section of this work. But it must be again repeated, and it cannot be too much insisted upon, that the basis of all precautionary and other measures relating to the domesticated animals is an efficient veterinary sanitary organization. Without this no measures can be carried out, and no country can expect to preserve itself from the serious losses and embarrassment inflicted by contagious diseases.

In a country like Great Britain, geographical position is greatly in favour of the adoption of efficient protective arrangements; while the imperative demand there exists for the importation of foreign animals in large numbers from many countries, renders it necessary that these arrangements should not only be complete, but that they should be attended to with the most scrupulous care and zeal. An insular country must be much more favourably situated for effectively carrying out such arrangements, than a continental one with an extensive frontier.

Foreign animals should only be allowed to enter at certain ports, and at these provision may be made for a thorough system of inspection, of quarantine if suspicion of infection is entertained, and of compulsory slaughter and burial should destructive contagious disease be actually present. When circumstances permit, it may even be possible to establish public abbatoirs at the ports of landing, for the slaughter of fat stock as food; this would greatly diminish the risk of contagion being introduced. If in all large inland towns there were public abbatoirs attached to or near the markets for foreign cattle, a similar advantage would be afforded; as cattle imported as fat stock for immediate slaughter might be conveyed direct from the port to the market, and thence to the abbatoir, without much chance of being brought into contact with home-bred cattle.

The risks would be even less if these markets and abbatoirs were near, or in communication with, the principal lines of railway.

It is absolutely necessary that there should be two markets —one for foreign, and another for indigenous stock; and the former should be isolated from the latter, the two classes of animals being kept as much apart as possible.

Not less necessary is it that the supervision of these markets and abbatoirs should be entrusted to competent veterinarians, whose special duty should be the inspection of the animals exposed for sale: their sanitary condition, and freedom from communicable disease, the arrangements of the

abbatoir, and particularly the healthy character of the flesh of the animals killed therein.

The carriage of animals by rail and steamship will also demand careful supervision: cleanliness, disinfection, proper treatment of the animals, &c., well repaying this care.

With regard to imported lean or store cattle, as these are almost certain to mix with home stock during fattening, a greater amount of attention must be paid to them at the port of arrival, and for some time after their departure thence, if quarantine is not imposed on their disembarkation.

Buyers of such animals should be particularly cautious in their mode of managing them for a few days after purchase, and they should be closely watched in order to ascertain whether they are healthy.

It would be very judicious for every purchaser of new stock to isolate it from the animals already in the shed or pasture, until its sanitary condition could be assured. A few days, in the majority of instances, would be sufficient for this purpose.

This *home quarantine* is a most excellent permanent preservative measure, and there are but few farms or dairies in which it could not be carried out.*

In continental countries, the same arrangements will suffice if we substitute for ports "cattle stations" on the frontiers. Cattle from other regions should not be permitted to travel except by certain frontier roads, and only be allowed to enter after the same precautions have been adopted as for seaports.

* Reynal points out that in Galicia, where there are large distilleries and important agricultural establishments, the owners, in consequence of the cheapness of cattle, do not hesitate buying in Russian Podolia, though well aware of the danger they incur from Cattle-plague. To preserve themselves from the risks attending this kind of dealing, they rely, not on the severity of the Austrian sanitary regulations, but on their own vigilance. They lodge these animals in stables in groups of twenty-five or thirty, according to the accommodation, and keep them there during a period of time equal to that of the incubation of this disease, closely observing them in the meanwhile. Should the malady manifest itself, immediate slaughter is resorted to, and it is not until all doubts are dispelled that the different lots are allowed to be together.

Their sanitary condition is an all-important point to be ascertained, and provision should be made for quarantine, in case this is not satisfactory; as well as for the destruction and interment of diseased animals, and appliances for disinfection.

PROVISIONAL MEASURES.

CATTLE-PLAGUE IN A DISTANT COUNTRY.

When it is reported that the Cattle-plague prevails in a distant country from which we receive importations, various considerations must be taken into account before the entrance of cattle is absolutely forbidden, and serious inconvenience perhaps thereby incurred.

The principal points to be considered are the measures in force in the infected or intermediate countries through which the imported cattle must pass; and the distance and mode of transit, with reference to the incubatory period, between the place of departure and that of arrival. For instance, if the disease is prevalent in the Danubian Principalities, or in the Russian Steppes, and cattle from these regions are purchased in the great fairs of the Austria-Hungarian empire for importation to this country, the excellent veterinary organization established by that nation, and which is chiefly directed towards the exclusion of this disease from its territory, affords a certain, and on the whole a sure, barrier against the infected or suspected animals. It is the same in the various German states; so it very rarely indeed happens that, during peace, other countries receive the contagion from or through them. Of course, certain eventualities might diminish our security in this way; but so long as matters remain as they now are, if the permanent precautionary measures are properly carried out, there is little reason to dread an invasion of the disease.

However, should the time occupied in transit be short, and less than the latent stage of the malady, or other circumstances demand it, it may be judicious to impose a short quarantine in the case of store animals, or even of fat stock.

Our security is less assured when the cattle arrive direct to us from a suspected country, like Russia, without having to pass through states where they may be inspected, and detained if diseased. In 1865, the malady was introduced into England by cattle brought from the Baltic port—Revel—and we have no guarantee whatever that it may not be introduced again and again in the same way if cattle from Russia are carried from the ports of that country to our own, without the greatest precautions and the utmost vigilance being exercised.

THE CATTLE-PLAGUE IN NEIGHBOURING COUNTRIES.

In dealing with such a subtle contagion as the Cattle-plague, and especially when our importations of foreign cattle are so great, and so likely to assume still larger proportions, yet greater circumspection is needed when the malady prevails in a neighbouring country. The measures to be adopted to prevent its introduction must then be supplementary to those permanently in force. These measures will comprise :—

1. The interdiction from that country of all animals capable of contracting the disease. Such animals as horses and pigs may be admitted ;

2. The natural products of bovine or ovine animals in a fresh or partially dry condition, with the exception of wool which has been washed for manufacture ;

3. Hay or other forage, and straw ;

4. Stable utensils or other articles which may have been in use with cattle.

If an insular country like our own is threatened, then on the arrangements made at the ports must depend its freedom from invasion. These arrangements may be only those in permanent operation, carefully carried out and supplemented by the above interdictions.

A continental country must exercise the same vigilance on its frontiers, particularly those which are not defined by well-marked natural limits.

Petty traffic in cattle should be particularly watched, and

animals carried on railways ought to receive the closest surveillance. Clandestine dealing in cattle is always a source of danger; and when the disease prevails on the continent of Europe, it is customary in the frontier departments adjoining the infected regions to forbid all large collections of animals, to stop the movement of cattle, to number those of farmers, cattle-dealers, and others, and only to permit their being sold for some special purpose, such as for food; with an injunction to give notice to the communal authorities of all changes occurring in the number of cattle in the stables or at pasture.

Of course, these measures are onerous, and will not always prove successful unless they are seconded by individual initiative. Reynal particularly insists on this; as without it, he justly remarks, it is to be feared the contagion of Cattle-plague will evade the arrangements adopted to check it.

It therefore remains with the administration to stimulate this initiative by every means in its power. The central veterinary committee or sanitary board should draw up a short, precise circular, addressed to all owners or holders of cattle, mayors, veterinary surgeons, police, agriculturists, and other likely persons, whose active assistance should be earnestly solicited. This circular should be printed and sent to those places most threatened; in rural districts it should be read by some local authority, and copies posted in conspicuous situations. Too much publicity cannot be given to an event of this kind, and it is the interest of all to aid in averting the ravages of such a terrible disease.

As it is in the highest degree necessary that the authorities should be informed immediately on the appearance of the malady, a reward should be given to those who first report its presence.*

* In Austria, a reward of fifty florins is given to any one who first reports the existence of Cattle-plague in a district; and to those persons who shall report the fraudulent introduction of cattle, on confiscation of the same shall receive a maximum sum of ten florins for each animal. A maximum sum of twenty florins is allowed to those who give information of infractions of any other orders. These rewards are paid by the Treasury.

The efficacy of this procedure is almost assured ; particularly as it is always adopted, as Reynal informs us, in threatened countries, and that Prussia, Bavaria, Belgium, and Switzerland suspend all fairs, close the markets, and prohibit the movement of cattle six miles from the infected place. In certain continental countries also, when the disease approaches their frontier, crossing this is forbidden, and troops are not unfrequently called into requisition; and not only are the commodities just specified interdicted, but also persons who are suspected of having been in the infected localities, or in contact with diseased animals. Before being allowed to enter the protected territory they must submit to disinfection.

In particular cases, it may be advisable or necessary that the introduction of the animals and articles stated above should be allowed from non-infected localities of a country in which the disease prevails ; but then they must enter by defined routes only, by railway or steamship if possible, and for each cargo of animals there ought to be a sure guarantee in the shape of an official certificate from veterinary surgeons entrusted with that duty, stating that the cattle or sheep are not suspected, and that they or the articles coming from these localities have not been in places where the disease prevails.

If the above interdictions are enforced, then there may be introduced from the non-infected localities of an invaded country—using every precaution, of course—by authority of the government, and on the conditions just stated :—

1. Animals for slaughter ;

2. Bones or skins completely dried, the points of horns, melted tallow in barrels, cow or goat hair, and wool and bristles, if these are closely rolled up or enclosed in sacking.

The ships or railway waggons which have conveyed the cattle should, at the port or station where they have discharged, be thoroughly cleansed and disinfected, and the persons who accompanied the animals, as well as those who loaded and unloaded them, should not go near other cattle until they have been disinfected. If there is any suspicion as

to the health of the cattle, they should be examined by a veterinary surgeon, who will give an opinion as to their condition.

Frontier or seaport quarantine should seldom be less than ten days, when deemed necessary. If the disease appears during that time, then, if all the animals are not destroyed, a new term of quarantine must be imposed, dating from the last case of death or recovery.

If the animals must travel by road, then certain highways or tracks should be indicated by which they shall proceed; these ought not to be near habitations, nor traversed, if possible, by other cattle; halting places should also be indicated where the creatures may rest and feed; at night they should be halted away from commons and villages, and carefully watched to prevent their straying.

SUPPRESSIVE MEASURES.

MEASURES TO BE ADOPTED WHEN THE DISEASE HAS INVADED A COUNTRY.

When, notwithstanding every precaution, the contagion has eluded the obstacles devised to prevent its ingress, and it appears in a country, another series of measures must be brought into operation.

The first of these relates to the declaration of the malady wherever it appears. When it has been ascertained that it really exists in a locality, whoever perceives that a cow or ox belonging to him, or entrusted to his charge, is suffering from a general disease, should at once report the circumstance to the local authority. If, within eight days, two or more cases of disease appear among cattle, or if only one falls sick while the Cattle-plague prevails in the locality, or if the nature of the sickness gives rise to a suspicion that it is the Cattle-plague, the chief authority in the place should inform the district administration.

While awaiting instructions or the arrival of the sanitary authorities, he ought to apprise the public of his suspicions, and promptly recommend all the owners of cattle not to allow

any persons in the pastures or sheds, but to have their animals attended to by one or more special servants, who will prevent, as zealously as they can, all communication with other people, and especially those whose cattle are sick.

The magistrates should order the sequestration or isolation of the stable or infected place, and forbid the passage of cattle, sheep, or goats from it, as well as depasturing.

The official verification of the presence of the disease should be made on the spot, and with the briefest delay possible, by the district authorities, who, with this object, will seek the aid of the district veterinary surgeon, or, if he is not readily accessible, that of any other qualified practitioner well acquainted with the signs of the Cattle-plague.

The chief authority of the locality should, if possible, be also present to render assistance. The commission so constituted will then visit the suspected animal or animals, without removing it or them. Supposing a number are suspected, and there is no dead body to examine, then one should be selected and killed, in order that a correct conclusion as to the nature of the disease may be arrived at.

If the information thus obtained be not sufficient to establish a certain diagnosis, but yet leaves some suspicion, the commission will order the sequestration of the place to be maintained. Every case of sickness or death among the cattle in the locality should be reported to the authorities, and the slaughter of animals from the suspected stables should only take place with the knowledge, and under the surveillance, of the veterinary surgeons.

These measures should remain in force so long as there is any suspicion of the existence of the Cattle-plague, and until the exact nature of the malady is discovered.

It it should prove to be the Cattle-plague, then all the necessary measures for its prompt extinction should immediately be put in force. In any case, the veterinary surgeon will proceed to make a return of all the cattle, sheep, and goats, at the same time ascertaining their state of health.

To do this, he should proceed with the greatest circumspection ; accompanied by one of the district authorities, the

non-infected places should first be visited, noting the number of bovine, ovine, and caprine animals they contain, with their sanitary condition, and only visiting the suspected or infected stables or pastures last.

MEASURES TO BE ADOPTED WHEN THE DISEASE APPEARS ON A FARM.

If the presence of the disease has been verified, the following measures should be enforced :

1. All the animals suffering from the disease, as well as those which have been with them in the same stable, farm, or pasture, or in contact with them in any other way, should be killed immediately, under the supervision of the commission.

2. The animals which have died of the disease, or been killed in consequence of exhibiting symptoms of it, should be buried in an isolated place ; before interment the hides should be deeply gashed by crucial incisions, so as to render them valueless ; the pits into which they are thrown should be at least six feet deep, and a thick layer of quicklime should be strewn over them before the pit is filled in. This we have already alluded to.

With regard to the slaughter of diseased and suspected animals, we have only to reiterate the opinion already pronounced in the second part of this work, as to the necessity and value of the measure as a means of suppressing or extinguishing the Cattle-plague. More especially is this step valuable when the disease first appears, and has not had time to extend itself in a country. Economical considerations must prevail when considering the suppression of animal plagues, and the more promptly they are extinguished at their commencement, the less loss and embarrassment will they occasion.

But we shall return to this question presently. We shall also refer to the utilization of the flesh of diseased or suspected cattle as food, as well as that of the skins and other animal products.

The farm in which the diseased animals have lived, as well as those creatures which have been in contact with them, should

be closely guarded, and, if necessary, placards should be posted around this farm notifying that it is infected with the Cattle-plague. Nothing should be allowed to pass beyond this place, and no one, except those belonging to it, should be permitted to enter; neither should any dweller therein be allowed to communicate with those outside, except under certain conditions imposed by the authorities.

Disinfection of the stables and utensils, according to the prescriptions already laid down, should be carefully carried out; and if the animals have been at pasture while diseased, the fields should be scrupulously cleared of all the excreta, which should be treated like that from the infected stables. The fields should not be tenanted again for a certain time after the disease has been eradicated.

MEASURES TO BE ADOPTED IN THE INFECTED LOCALITY.

While these measures are being applied to the stables or fields actually infected, other measures must be enforced in the locality in which these are situated.

This locality should be declared infected, and the declaration ought to be made public; its isolation or sequestration should be made as complete as circumstances will permit.

The exportation, importation, and the movement of cattle, sheep, or goats should be forbidden, and the raw products and *débris* of such animals—flesh, tallow, skins, hair, wool, bones, horns, &c.—must not be carried beyond the prescribed limits; neither must manure, forage, or matters which have served, or may serve, for litter.

These measures must remain in force during the existence of the disease, and as long after as the authorities may deem necessary; and their execution and superintendence should be entrusted to trustworthy and intelligent men. Policemen, or even troops, may have to be employed for this purpose.

It may be necessary to fix placards at the roads leading to the infected locality, intimating that the Cattle-plague prevails there.

In these localities, every death occurring among cattle, sheep, or goats, and every case of disease among these animals, should

be promptly reported to the proper officials. Sheep and goats should be kept apart from cattle, and not be allowed near them again during the prevalence of the disease.

Should oxen be used for draught purposes, their employment in this way must be forbidden until the malady has been suppressed.

Animals likely to convey the contagion, as dogs, cats, poultry, &c., should be kept away from the diseased cattle, and confined as closely as possible.

Great attention should be paid to the movement of people to or from the locality, and it is always advisable to suspend this as much as circumstances will permit. Those people who have not, from the outbreak of the disease, been in contact with sick or suspected cattle, nor have frequented places where the malady existed, may be allowed to pass to and fro; but those who have been so exposed, should not be granted this privilege, at least until every precaution has been taken in the way of disinfection, &c.

From all the non-infected stables the manure should be removed every day.

The fairs and markets in the locality should be suspended, and the carriage of animals, or their products, by railway should only be permitted on condition of observing the precautions issued by the authorities.

The conveyance of cattle, or their products, forage, and litter, from the locality should be absolutely forbidden during the existence of the malady.

If the disease appears in a large town or extensive locality, but only in isolated parts, the authorities may limit their operations to these points, applying their measures of isolation, &c., to them.

Or if it exists in a farm away from any village or town—say for a distance of one third or half a mile, the measures just indicated should be confined to it, and not to the town or village if they are free from the contagion.

MEASURES TO BE ADOPTED IN AN INFECTED DISTRICT.

When the disease reigns in a locality, all contained within a radius of three miles around it should be reckoned as an infected district.

In Austria, every owner of cattle within this district must, within twenty-four hours following the publication of these limits, furnish the local authority with a list of all his cattle, indicating their number, age, sex, colour, and particular marks. From the receipt of this, all changes occurring in his stables or pastures, whether by exchange, purchase, or births, have to be reported; and in the case of purchase the derivation of the new animals has to be mentioned. This information is expected to be furnished to the authority within twenty-four hours after the event.

Similar measures are to be applied to the infected district as to the infected locality. Every death or case of sickness among the cattle, sheep, or goats should be immediately notified; and every dead animal should be left untouched where it has died, until the authorities have seen it.

The fairs and traffic in cattle, as well as carriage of forage and litter, should be interdicted; and, in particular instances, the authorities may order that all the cattle in the infected district shall bear a special mark.

If there is any danger of the disease extending to the neighbouring localities, depasturing should be interdicted in these.

The same care should be taken with dogs and other animals as in the case of infected localities.

If the malady has invaded a considerable district, the infected country should be divided into sections, for each of which there should be a Cattle-plague commission.

In order to ensure unity in the carrying out of these measures, the superior direction of an infected district, particularly when it is very extensive, should be confided to a Government official, with whom is associated a thoroughly competent veterinary surgeon.

MEASURES TO BE ADOPTED IN AN INFECTED PROVINCE.

When the disease appears in a locality of a province or county, the occurrence should be immediately made public, and the Minister of the Government, who has the control of home affairs of this kind, should be apprised.

The authorities in the adjoining counties, or those which have numerous and direct relations with the infected province, through dealings in cattle, and especially if these are carried by rail, should also be notified of the circumstance as quickly as possible.

If the malady only appears in a small extent of the province, and is confined to a few localities, the relations of the non-infected parts with other provinces need not be interrupted, nor suffer any restrictions other than those resulting from the arrangements prescribed for the infected district: provided always that the localities in which the disease prevails are rigorously isolated and supervised.

Should the Cattle-plague have become considerably extended in a county, and the centres of infection have become multiplied, the most active steps should be taken to extinguish the contagion; and the county should be regarded by the neighbouring counties in the same light as an infected foreign country, with respect to dealings in animals and their products, and all communications with it.

TERMINATION OF THE DISEASE.

The measures prescribed for the extinction of the contagion should cease when it has been officially declared that the disease is suppressed. This announcement ought not to be made within less than twenty-one to thirty days after the last death, or the slaughter of the last suspected animal, should no fresh case occur in the interval; and after disinfection has been completed, and a last revision of the animals made to ascertain that there remains nothing of a suspicious nature.

The stables and pastures which have contained infected cattle, and which have been cleansed and disinfected, should

not be occupied by bovine, ovine, or caprine animals until the epizoöty has been declared extinct.

The new purchases should be obtained only from places free from the disease, as its re-appearance in a locality is nearly always due to imprudence in this respect; and the authorities should satisfy themselves as to the observance of this precaution. The animals should likewise be inspected before they are allowed in the stables or pastures; and if possible they ought to be isolated for from ten to fifteen days.

THE MOST URGENT MEASURES IN THE SUPPRESSION OF CATTLE PLAGUE.

1. *Isolation.*

Though all the measures we have specified are essential in the suppression of Cattle-plague, yet there are some which demand the greatest promptitude and attention in their application. The chief of these is that related to ISOLATION. This is the measure *par excellence;* and upon its timeliness and the rigour with which it is carried out, will mainly depend the rapid extinction of the contagion, with the least loss and inconvenience. Every centre of infection should be cut off from all dangerous communication with the non-infected localities, and particularly with healthy cattle. No strangers should be permitted to visit the places in which the diseased or suspected cattle are kept, and only particular persons should be allowed to attend to these. While they are about the animals, they should wear clothes and boots which must be kept in the stables, and changed when the individuals go away.

Knowing that the air may carry the contagium for a certain distance, precautions must be taken, and windows and doors of stables should be closed when the wind prevails in a certain direction. Water will also convey it, and streams and watering-places should, therefore, be carefully watched. Animals of different species can likewise transport it, and these ought to be sedulously kept away from the diseased or suspected.

Numerous instances are recorded in which the disease has been averted by this measure, though the animals were surrounded by it. But these healthy animals were isolated in the same

manner, and with the same care as we have prescribed for the diseased, and new purchases were not made, the roads and stables were zealously guarded, and all risks of contamination from without wisely provided against.

Therefore, when the disease appears in a district or a locality, ISOLATION should be the first measure adopted, and that which, of all others, must be most scrupulously enforced ; the next is that which has for its object the extinction of the contagion. This is the slaughter of the diseased and suspected.

2. *Occision.*

This measure stands next to isolation, in point of value, in suppressing a disease like the Cattle-plague ; and, like that measure, it is most beneficial and satisfactory when carried out at the commencement of the epizoöty. Then but few animals are diseased, and perhaps only a small number have been in contact directly or indirectly with them. Consequently, to slaughter these is but a trifling sacrifice, compared with that which a few days' delay may necessitate. To do this, to bury the carcasses deeply, and to adopt the precautions already indicated, is not an onerous duty, and if performed as it should be, must prove eminently successful.

When the malady has assumed large proportions through supineness, ignorance of its nature, attempts to cure it, or other circumstances, then the question of occision is not so readily answered. To slaughter all the diseased and suspected animals over a wide extent of country is a terrible sacrifice and a national loss and misfortune, and has often given rise to severe comments, and strong protestations and opposition. In such a calamity as a wide-spread epizoöty of Cattle-plague, the balance is between the loss inflicted by the disease and that incurred by the remedy. It is certainly a most serious reflection that so many cattle, and so much animal food, should be destroyed in the attempt to subdue a disease whose existence and extension depend upon its contagious properties only. But as we have seen, if isolation and the other precautions short of slaughter could be adopted universally, and religiously and patriotically carried out by

those whose interests are most at stake, it is certain that the severe measure of occision could be largely dispensed with; and where it had to be adopted, the loss attending it might be mitigated by the utilization of part, at least, of the flesh as food, and the preservation of the skins, &c., by proper disinfection. Such is certainly the opinion of Reynal, whose experience during the epizoöty in France so recently as 1870-71, as well as in other parts of the continent before that date, has been made largely available by the Government of his country.

But where isolation cannot be strictly complied with, and the legislative measures short of slaughter are neglected, or perfunctorily carried out through defective organization, then occision must be adopted: though not in a rash or indiscriminate manner, but with all the deliberation and circumspection which such a severe ordinance demands.

The experience of this country, Belgium, and Holland in 1866, that of France in 1870-71, and that of Germany and other countries on very many occasions—indeed the whole history of the malady previous to these dates—proves that even when Cattle-plague is wide-spread, and is maintained by numberless foci of contagion, slaughter of the diseased and suspected, with interment of the carcasses, disinfection, and other measures of a sanitary kind, were the only means that could be adopted with any likelihood of success.

3. *Indemnity or Compensation.*

The last measure, occision, will seldom be tolerated or prove anything like successful, unless the owners of cattle destroyed to prevent the extension of the contagion are remunerated for the sacrifice they are called upon to make on behalf of the nation. All enlightened governments have recognized the great utility of this concession, in the promptitude with which it enables them to stamp out the contagion. We have alluded to this in the second part of the work. We have only now to note that the amount of this compensation must vary with circumstances.

When the disease first appears in a country or in a locality, it may be most judicious to allow the full value for animals

diseased or suspected, in order to ensure the rapid extinction of the contagion. If no compensation is allowed, or if this be insufficient, this result will not, in all probability, be attained, for the reasons stated elsewhere.

This liberal indemnity will, of course, tempt dishonest and unpatriotic men to act unfairly, to impose upon the authorities, and lead in the end to great abuses. It will, therefore, demand much tact and discrimination in awarding it.

Neither would it be proper to allow it at all periods of the malady, or when the epizoöty has become general. The amount to be given must then depend upon circumstances, and also upon the sums realized by the sale of the carcasses of suspected animals.

Compensation should certainly not be given to those who have infringed the laws relating to the disease; and all owners of cattle who are proved to have introduced the disease, or who have not duly reported its existence among their stock, should be excluded from the list of recipients; also those who have omitted to take proper precautions in the way of isolation, disinfection, &c.; neither should compensation be granted unless the animal has been in the possession of the owner at least thirty days, except at the very commencement of the outbreak.

If the full value, or even a portion, were always allowed for diseased and suspected animals which, by the decision of the authorities, must be killed, it would cause owners to be careless of sanitary measures, and guarantee the dishonest purchaser against the risks of his fraudulent traffic.* This indemnity

* In the history of the Cattle-plague, and the laws devised to check its extension, we always find that dishonest motives have more or less inflenced men in making the most out of such a calamity as this always is, and that the greatest vigilance was necessary to guard against fraud. More especially has this been the case when compensation was allowed; and so much have abuses prevailed at times, that the principle of indemnity for losses sustained by the disease has been frequently suspended. Even so late as 1870-71, in France, the wide interpretation put upon the general principle of the law of indemnity often had the result of inducing fraud, and led to evil consequences. This was especially the case when full value was allowed for diseased or suspected animals destroyed by order of the authorities. It

should either be paid out of a local rate or by the Treasury. Both of these modes have something to be said in their

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was to guard against this abuse of a generous and most efficacious act that the French Republic issued a decree on the 30th of September, 1871, modifying the law of June 30, 1866, which allowed for all animals killed in consequence of Cattle-plague three-fourths of their value. As this decree was productive of excellent results, and has reference to other important points in the suppression of the disease, it may be useful to quote it here :—

Article 1. The indemnity of three-fourths of the value allowed by the law of June 30, 1866, to the owners of animals killed by order of the public authority, shall be fixed by the Minister of Agriculture and Commerce, after an inspection made at the moment when slaughter has been determined upon.

Article 2. The valuation of the animal is made by two experts, one named by the mayor, the other by the owner. Should the latter not name an expert, the one selected by the mayor shall act alone.

The official report of the inspection shall be deposited at the mayoralty.

In case of dissension between the two experts as to the value of the animal, the mayor shall take the subject into consideration.

Article 3. The official report shall be transmitted within five days of its date by the mayor to the préfet. It should be accompanied : 1. By the order for slaughter given by the mayor, on the report of a veterinary surgeon ; 2. By a certificate from the mayor, stating that the animal has been killed ; 3. By a certificate from the mayor, showing that the owner has conformed to the laws and regulations of the sanitary police, especially with regard to the declaration of the disease as soon as it appeared ; 4. By the demand for indemnity drawn up by the owner.

The minister will be allowed to delay his action for three months from the date of these documents.

Article 4. When the Cattle-plague appears suddenly in a locality, and there are only a small number of suspected animals, the carcasses should be buried or destroyed on the spot by the proceeding known as *équarrissage* (cutting to pieces, as is done by knackers).

If the disease has extended over a wide surface of territory, the use of the flesh of slaughtered animals may be allowed by a decree of the préfet. This decree shall determine : 1. The conditions under which the transport shall be permitted, either of the flesh, or of the living suspected animals, from the place in which they have been kept to that where they are to be consumed or killed ; 2. The precautions to be adopted to prevent the living animals being removed from their destination, and to guarantee that they shall be killed immediately on their arrival at the abattoir.

Article 5. In the cases provided for in the previous article, the money yielded by the sale of the flesh shall be left with the owner of the animal.

favour; but, on the whole, perhaps the first is, in the majority of cases, to be preferred.

4. *Enumeration.*

The estimation of the animals necessarily destroyed because of Cattle-plague is not in all cases an easy matter, if justice is to be done to the owner and the state; and the difficulty is nearly always owing to the absence of any fixed principle by which the indemnity can be regulated. And yet it is necessary that there should be some standard, and also that the estimate should be fairly made; for unless this is assured, the law as to compensation cannot be satisfactorily carried out.

The differences in valuation must depend upon a variety of circumstances, and according as one or other of these predominates in the estimation of the experts. The local value of animals is not the same everywhere, and their particular qualities will also be differently valued in different districts: milch cows being valued most in one, breeding cattle in another, and fat stock in another. So that it is not always easy to arrive at what may be designated the fair compensation for an animal; unless Reynal's suggestion be adopted, that its marketable value, if sold to the butchers for food, be made the basis.

However difficult the task may be, the experts have always to remember that their duty to the public should raise them above all personal considerations; and while anxious to act fairly towards owners of cattle, they ought none the less to protect the Treasury from imposition and needless loss.

The experts may be a veterinary surgeon named by the authorities, and another chosen by the owner of the animal to be destroyed. These may be aided in their task by non-professional men, selected for their impartiality and knowledge of the value of animals.

But if it exceeds one-fourth the value of that animal, then the indemnity of three-fourths allowed by the state shall be proportionately reduced.

Article 6. The expense of inspection, slaughter, burial, disinfection, the transport of flesh or suspected animals, and all other accessory expenses, shall rest with the owners.

5. *The Suspension of Fairs and Markets.*

When the disease has attained any degree of extension, the interdiction of cattle fairs and markets should take place, and all open or clandestine movement of cattle ought to be absolutely proscribed, more especially the latter, as it is in the majority of cases the most fertile agency in disseminating the contagion. Therefore it is that the persons who are likely to embark in this business should be closely watched, and if discovered in their nefarious proceedings, a severe punishment should be awarded them. The low price at which cattle-owners will dispose of their animals when the disease appears among them is too tempting an opportunity to a certain class of men to be resisted; and they accordingly invest a small sum on the chance of selling at a great profit in some other part of the country—thus spreading the malady.

The suspension of fairs and markets, and general restrictions as to movements of cattle, should be maintained until the complete suppression of the disease.

6. *The Supervision of Railway Traffic.*

Railways have done much in recent years towards rendering the diffusion of Cattle-plague more easy and rapid, and its introduction into remote localities a certainty, unless great vigilance is exercised. We had an instance of this in 1865, when the contagion of the Cattle-plague was carried from London to Aberdeen, and the disease was observed there almost as early as in the metropolis.

The railway stations demand the closest scrutiny in this respect.

Fat cattle for immediate slaughter may be allowed to travel, provided they are accompanied by a certificate as to their health, and whence they come. These certificates may be given by competent and recognized authorities, and the carrying out of slaughter should take place without delay.

When a country like England is largely invaded by the disease, the railway traffic in cattle is so important a matter

that it demands the greatest attention from the authorities. It may happen that new regulations will have to be framed to regulate it, and skilled persons appointed to superintend the observance of these, and more particularly a chief director.

UTILIZATION OF FRESH SKINS, HORNS, TALLOW, WOOL, AND HAIR.

We have enumerated these articles in our proposed sanitary measures as objects to be excluded from uninfected countries or localities, because they are likely to convey the disease. They figure in the list of dangerous commodities in all the sanitary police enactments of foreign countries; and yet there is no very strong proof that they have ever been the cause of an outbreak of the malady, though they have sometimes been suspected. Nevertheless, it is always best to err on the safe side in such a matter, and if these articles are to be admitted, it should be stipulated that they have been freed from all possible danger by disinfection.

Röll recommends that only the skins of those animals which have been killed as suspected, but which on a *post-mortem* examination are recognized to be yet healthy, should be kept and disinfected: those from diseased animals being extensively slashed before interment, and buried with the carcass.

Disinfection should be carried out under the supervision of the veterinary surgeon, and is most easily done by plunging the skins in lime-wash, one or two pounds of quick-lime to the bucket of water. There they should remain for twenty-four hours, and then be dried in the open air; or they may be suspended on posts in a closed shed, and exposed twelve hours to the vapour of burning sulphur, and afterwards dried for eight days. If there is a tanner in the locality, they may be given to him on condition that he will immerse them at once in the tan-pits.

PRECAUTIONS WITH REGARD TO SHEEP AND GOATS.

As the disease may be introduced by sheep and goats, through their cohabiting with sick cattle, and as these animals

are themselves liable to suffer from the contagion when it prevails in an exceptionally virulent form among bovines, they must be also made amenable to sanitary restrictions. It is possible that in many cases the enactments applicable to cattle would be too severe when applied to sheep and goats; and, indeed, recent experience demonstrates that the dangers apprehended from the movement of sheep during Cattle-plague epizoöties have been greatly exaggerated.

And the disease itself, when it affects these animals, is far less serious than it is in cattle.

When, therefore, the malady is accidentally transmitted to a flock of sheep, the sanitary authorities must act upon this knowledge, and upon varying circumstances will depend the character of the measures they shall adopt. The isolation of the infected flock must be the principal measure, and its surveillance during isolation must of course follow. Whether the movement of other flocks shall be suspended or modified, must depend upon circumstances. As the disease is seldom serious, occision will seldom be resorted to, unless special circumstances should lead to the apprehension that the contagion may be extended to cattle.

PUNISHMENTS FOR INFRACTION OR NEGLECT OF THE SANITARY LAWS.

The punishments for neglect or infraction of the measures prescribed by the authorities should be of a severe and exemplary kind, especially when fraud comes to be added to the offence. The great amount of injury that may result from carelessness, imprudence, or dishonest dealing, renders it imperative that prompt and effectual penalties should be awarded for every offence.*

* In Austria, every infraction of the legal prescriptions, if not provided for in the general penal code, is punishable by an imprisonment of four months at the most, or a maximum fine of five hundred florins. The same fine is imposed upon every chief of a commune, or his delegate, who neglects to report cases of disease, or gives a false certificate. Any negligence is punished in the same degree. Every culprit, in addition to the fine, has to make good the loss caused by his negligence or imprudence.

Exceptions should be made, however, in cases in which a plea of ignorance can be fairly urged. The subtle nature of the contagion, its period of incubation, and the early symptoms of the disease are not likely to be always appreciated by every one who has to do with cattle; and in order to abolish this plea, prevent accidents, and enlighten the public as to the nature of Cattle-plague, the notices announcing its threatened invasion, or actual presence, should also contain a lucid account of everything connected with it, either in a medical, legal, or sanitary point of view.

PROTECTIVE MEASURES.

INOCULATION.

Inoculation with the tears, saliva, nasal mucus, &c., from slightly affected cattle, as a means of inducing a milder form of disease in the animals yet unaffected, is not to be recommended; as there is no proof that the malady is produced in a less malignant form than if transmitted naturally; and, besides, this inoculation may continue the prevalence of the disease for a much longer period than if it was not resorted to, and may cause considerably greater losses.

It can only be recommended in those extreme cases in which it is deemed advisable to *shorten the duration* of the epizoöty—as when the malady has acquired vast proportions and when, in consequence of the numerous modes of communication, there is scarcely any possibility of preventing its general dissemination. The object in resorting to this serious alternative is to infect at one time all those animals which have hitherto escaped the disease, but which, by becoming successively affected, would prolong the reign of the scourge over a long period. Inoculation is then performed by inserting cotton or worsted thread impregnated with the virus (nasal mucus or tears) from an animal suffering from a mild attack, or in the first stage of the disease, beneath the skin of some convenient region, as the inner aspect of the thighs, the back, chest, or dewlap; these threads are allowed to remain until

swelling takes place around them, and the morbid symptoms appear.

This inoculation is, however, such a serious measure, and one fraught with such dangerous consequences, that nothing but the most urgent and extreme peril can justify its adoption.

As a *preservative* measure in those countries in which the disease is known to appear enzoötically, and in a much less serious form than in lands to which it is foreign, this inoculation may be judicious; as it guarantees cattle from a second attack at a comparatively small cost, and thus obviates the danger of infecting the herds of other regions among which they may be imported. If all cattle derived from the pest-haunted countries could be guaranteed as protected from the disease by having already had it, an immense risk would be abolished, and a great advantage gained in cattle traffic. It must be stated, nevertheless, that since its introduction by Dodson, in 1744, inoculation has been tried on an extensive scale, particularly in Russia, and has been experimentally tested in almost every possible manner, but the results have not yet afforded any sanguine hopes that this object is near its achievement.

It has been demonstrated, from the Russian experiments, that no mitigation of the virulent principle can be obtained by cultivation of the virus, even after fifteen generations. Besides, it has been left with the owners of cattle to practise inoculation voluntarily, only compelling them to adopt certain precautions if they care to resort to this operation. It is, therefore, evident that but few proprietors will entertain the risk of loss and the trouble of inoculation, if they can dispose of their cattle without it. If it is to be successfully carried out, it should be rendered compulsory, and the countries which are exposed to invasion should insist that none but animals which have been successfully inoculated, or have had the disease from natural infection, be admitted within their boundaries.

It is needless to say that vaccination and variolization are impotent in affording immunity from the disease.

SYMPTOMS OF INOCULATED CATTLE-PLAGUE.

The symptoms of the inoculated disease, as witnessed in the Steppes, are said to differ from those which appear when it has been produced in a natural manner. In the former, the first manifestations are witnessed after a variable period—from the third to the sixth day, very rarely beyond the eighth or ninth day. The earliest indications are fits of restlessness, tossing the head, whisking the tail, pawing and kicking, and, at intervals, a slight dry cough. Then succeed dulness and prostration, and a desire to separate from the other animals; the beast lies extended at full length, general and partial tremblings are observed, and shiverings, particularly in the ulnar and patellar muscles; a paroxysm of fever sets in, which lasts from one to six hours. After this paroxysm, which at times terminates the disease, the animal gets up, and its liveliness and appetite reappear; but there may occur a relapse of greater severity; and when these relapses persist uninterruptedly, it is an indication that the fever is assuming a putrid character. The pulse is small, quick, irregular, and intermittent, and is imperceptible towards the close of the malady.

The region of the loins is very sensible, and the animal nearly falls when pressure is made in this part; the visible mucous membranes are dry, at first red-coloured, and, if the disease continues, subsequently a pale yellow, then a bluish hue; the matter discharged is thick and stringy, the eyes are tearful, the muffle is hot and dry, and the ears, base of the horns, and limbs are cold. To constipation succeeds a serous Diarrhœa, which soon becomes frothy, fetid, and blood-tinged, and is alternated with tenesmus. The respiration is difficult and plaintive, and at last the animal lies or falls down, throws the head round to the side, and stretching out its limbs rigidly, dies most frequently without any convulsive movement. Cows in calf nearly always abort before death occurs. When emphysema appears about the back, it is always a very unfavourable sign.

According to Stephannoff, the inoculated disease presents this peculiarity: that it is nearly always mortal when the

symptoms appear four or five days after inoculation. Before the fifteenth day is the crisis ; if the animal lives beyond this period, recovery is certain in the majority of cases.

The progress of the malady, according to the same authority, quoted by Reynal, is influenced by age, sex, the physiological condition of the animals, their individuality, the season, temperature, and the state of the atmosphere. Therefore it is that young animals withstand its effects better than adults, bulls, and cows in calf. Those seasons which are uniform in temperature, as the summer or winter, are more favourable for inoculation experiments than spring or autumn. The operation also succeeds better with Steppe than other cattle, in which it produces quite as serious a form of the disease as that induced naturally.

CURATIVE MEASURES.

When Cattle-plague invades a country, its medical treatment should not for an instant be tolerated. The likelihood of effecting a cure is so exceedingly remote, the mortality is so high, and the danger of disseminating the disease so great, that attempts in this direction ought not to be permitted. All methods of treatment, tried under the most favourable circumstances, both as to breed, time, and locality, and by the most competent veterinarians, have proved that there is no certain remedy, no successful method—all the vaunted specifics proving impotent, many of them hurtful. Essays to discover cures and methods of treatment should only be made in those countries in which the disease shows itself in the mildest form, and especially in those where it is supposed to be indigenous. The result of attempting to cure such a formidable contagion in a country to which it is foreign, is painfully exemplified in our experience of the disease in England in 1865-66.

When, however, the disease has become general, and there is no reason to hope that it can be suppressed by the isolation and slaughter of the sick and suspected, medical treatment might be allowed ; but, at the same time, the most stringent sanitary police measures should be maintained.

The kind of treatment to be adopted is indicated by the symptoms and the tendency of the disease. It must be remarked, however, that careful nursing, attention to diet—which should be chiefly in a fluid or semi-fluid form—cleanliness, and proper hygiènic measures, have hitherto yielded more satisfactory results than haphazard medication and energetic antiphlogistic treatment.

THE USE OF THE FLESH OF DISEASED OR SUSPECTED ANIMALS AS FOOD.

Leaving out of view the question whether the flesh of animals affected with, or suspected of, Cattle-plague is absolutely altered in quality or nutritive value, it becomes an important point to decide whether the consumption of such flesh entails any danger to health from its virulent or altered properties.

This question of the salubrity of the flesh derived from diseased animals is, as we shall see hereafter, of much moment, and worthy of due consideration; for though its nutritive properties may be diminished, and it may be inferior in several respects to that obtained from healthy cattle in good condition; yet it must be remembered that so long as it does not produce disease or any deterioration in the sanitary state of those who consume it, and so long as its issue does not, directly or indirectly, entail any risk, so far as the extension of the contagion is concerned, a great boon must be conferred on a population by allowing this flesh to be utilized as food, while the loss inflicted by the disease will be proportionately diminished.

It is certainly by all means to be desired that nothing but the flesh of healthy animals should be permitted to be used; but with certain classes there is no choice between beef of excellent quality and that of inferior value, and the latter must either be taken, or these people must abstain altogether from animal food.

With regard to the flesh of suspected animals, there can be no doubt whatever as to its innocuousness, and it may be unhesitatingly issued for consumption in the infected locality, after the permission of the proper authorities has been obtained.

The propriety of utilizing the flesh of diseased animals has been discussed for more than a century and a half. When the disease ravaged Italy in 1711, the government of Venice consulted the Faculty of Padua, as to whether such flesh should be allowed to be sold by the butchers; and after a long debate it was decided by that body that its use was unattended with danger. Its sale was accordingly tolerated, and no inconvenience ensued. In 1714, the same result was noted; and in 1775, while the plague raged in the southern provinces of France, the flesh of diseased animals was consumed by three-fourths of the inhabitants in consequence of its cheapness, and no instance of inconvenience therefrom was recorded. Indeed Dufot, who reports the circumstance, asserts that the most perfect health prevailed, and that for forty years there had not been witnessed so little sickness as during the time this food was in the market.

The same kind of evidence comes down to us through the long history of the disease. The population of the countries in which it has reigned in all its virulency, as well as the armies in whose commissariat parks it wrought such havoc during continental wars, have resorted to it without suffering the least ill effects. In China, at Hong-kong, in 1860, the Chinese consumed the flesh of all the animals that perished—even after these had been towed out to sea and were washed up again on the beach—and nothing unusual was observed in their health.

In this country in 1865-66, there can be no doubt that there was a regular traffic in such flesh, and yet there is not a case on record in which disease could be attributed to it. It was regularly consumed in several departments of France during the late war; in Paris at one time after the siege the population had none other but the flesh of plague-stricken cattle to eat, and instead of the mortality increasing it decreased.

The practical facts, therefore, in favour of the innocuousness of this flesh are innumerable and irresistible, and altogether demolish the hypothetical fears conjured up by persons who had no experience in the matter.

The flesh of animals which have been killed in consequence

of being diseased may, then, if circumstances render it urgent, be allowed for consumption in the infected localities without any very great precautions.

When, however, the supply is greater than the demand in the locality or district, it becomes a serious question whether the surplus quantity can be safely permitted beyond the infected radius. Reynal asserts that, with certain precautions, it may; and his extensive experience in France during the recent wide-spread and severe invasion is brought forward in support of the assertion. He says that it is sufficient to envelop or pack up the suspected flesh in baskets, and carry it, without any stoppages, in close waggons carefully watched, to avert all risk of contagion. Before placing other goods in the waggons, these should be most throroughly disinfected, under the superintendence of a special agent of the administration; as well as those waggons which are used in the conveyance of suspected animals or their products during the prevalence of the disease.

This precaution, which is invariably adopted on all the German railways, is of the first necessity. It is a certain and necessary public guarantee. Of course every measure of this kind has for its object the preservation of healthy cattle from the contagion; and no matter of detail, however insignificant it may appear, should be neglected. Therefore, if it be deemed judicious and beneficial that the flesh of diseased or suspected animals be made available for public consumption, every care should be taken that its issue and transport do not extend or maintain the malady.

THE USE OF THE MILK AS FOOD.

As with the flesh, so with the milk of cattle suffering from this disease. There is no evidence that its use is likely to prove hurtful; and were it otherwise, the diminution and suppression of this fluid at a very early period of the disease must effectually prevent any accidents, were they likely to occur.

CONTAGIOUS PLEURO-PNEUMONIA OF CATTLE.

SYNONYMS.—Technical: *Peripneumonia pecorum epizoötica typhosa, Peripneumonia exsudativa contagiosa, Peripneumonia exudativa enzoötica et contagiosa, Peripneumonia s. pleuro-pneumonia pecorum enzoötica, Pleuritis rheumatico-exsudativa, Pleuro-pneumonia interlobularis exsudativa, Pneumonia catarrhalis gastrica asthenica.* English: *Lung-disease, Lung-sickness, Lung-plague, Pulmonary murrain, Epizoötic pleuro-pneumonia.* French: *Pleuro-pneumonie contagieuse de la bête bovine, Mou pourri, Pneumosarcie, Peripneumonie maligne, Peripneumonie gangreneuse, Murie, Pleuro-pneumonite contagieuse, Pulmonie epizootique.* German: *Lungenseuche des Rindes, Chronische Lungenseuche, Typhose Lungenseuche, Lungenfaule, Krebsartige Lungenfaule.* Dutch: *Kwaadaardige Slijmziekte, Heerschende* or *Besmettelijke Longziekte, Rotachtige Longziekte.* Italian: *Pulmonera, Pulmonea dei bovini, Pleuro-pneumonia essudativa, Polmonea cantagiosa bovina.* Bengalee: *Phush phush pirdaho, Pheepree.*

GEOGRAPHICAL DISTRIBUTION.

The earliest notices of this malady testify that it first prevailed in Central Europe. In the last century it was present in certain parts of Southern Germany, Switzerland, and France, and had also appeared in Upper Italy. Though Valentine described an epizoöty occurring in 1693, in Hesse, yet doubts have been entertained as to whether it was this disease. It is not until 1769, when Bourgelat, the founder of the French Veterinary Schools, makes known the existence of a disease in Franche-Comté, and known as "murie," that we have any certain indication of its presence. From that date down to 1789, the malady appears to have remained more or less limited to the mountains of Switzerland, the Jura, Dauphine, Vosges, Piedmont, and Upper Silesia; it showed itself in Champagne and Bourbonnais, between that period and the French revolution, when an impetus seems to have been given

to its diffusion by the wars that soon followed, and the consequent demand for cattle for the commissariat parks. The increasing commercial relations between various countries have carried it far beyond the regions in which it first prevailed.

In this century its course has been pretty accurately determined. It invaded Prussia in 1802, and soon spread over North Germany. It was first described as existing in Russia in 1824; it reached Belgium in 1827, Holland in 1833, Great Britain in 1841, Sweden in 1847, Denmark in 1848, Finland in 1850, South Africa (Cape of Good Hope) in 1854, the United States of America (Brooklyn in 1843, New Jersey in 1847, Brooklyn again in 1850, Boston in 1859), Australia (Melbourne in 1858, New South Wales in 1860),* and New Zealand early in 1864.†

* The extension of the disease in Australia is typical of its introduction and spread in other countries. It was introduced by means of an English cow, imported into Victoria, and landed at Melbourne in 1858. When the disease was discovered among the importer's cattle, steps were at once taken to eradicate it. All the cattle on the farm were paid for by private subscription and destroyed, and the farm placed in quarantine. Unfortunately, however, the quarantine was not strictly maintained, and a greedy ignorant neighbour, who owned several teams of working bullocks, which he usually employed in carrying on the roads, seeing the good grass in the infected paddocks, put his cattle into them during the night and removed them at daybreak. His cattle soon became infected; and as he shortly after sent his teams on the roads on a journey to the border of the colony, they spread the disease in all directions as they went. His other cattle again mixed with his neighbours', and the malady was in like manner diffused around his own farm.

In this way it soon spread to the other colonies, and is now more or less prevalent in them all; travelling stock are so frequently affected that no sooner has a fresh race of animals grown up, which have neither had the disease nor been inoculated, than they are infected by cattle travelling through their "runs."—*Bruce:* "Veterinarian," 1873, p. 525.

† The disease is said to be known in India, but more proof than the Indian Cattle-plague Commission has afforded is necessary to establish the fact. They say: "It is undoubtedly met with throughout India. The people of the Punjab were very familiar with the disease, and described its symptoms accurately. It causes an annual loss of nearly two per cent. of cattle in the Hissar district, where it is called *pheepree.* The disease would also appear to be common in Sind; it is possible that it may have

It is also said to have been carried to Asia Minor, and quite recently it has prevailed at Damascus. In Austria it is less prevalent than in some other European countries, and it is scarcely known except in Bohemia, Moravia, and a portion of the Tyrol. In Hungary it appears to be almost unknown, in consequence of the minimum importation of foreign cattle; and in other countries to which it has not been introduced by infected animals it is not seen. Thus it is unknown in Normandy, and also in Algeria.

CHARACTER.

This Pleuro-pneumonia of cattle is a specific and contagious disease peculiar to bovine animals, and of a sub-acute or chronic character. It usually appears as an epizoötic or enzoötic malady; and in consequence of its insidious invasion, the subtlety of its contagium, its general diffusion, and the great fatality attending it, it is a most serious scourge.

In every country in which it has appeared, it has caused an immense destruction—perhaps greater on the whole than Cattle-plague; as in very few countries have any active steps been taken to eradicate it, because, there is every reason to believe, its ravages are not so strikingly apparent as those of that disease.

It consists essentially in a pulmonary interstitial exudation of lymph, one or both lungs being involved, with complication of the lining membrane of the chest, and effusion and exudation into that cavity. One attack confers immunity against another, and the disease does not extend to other species; it spreads in our regions only through contagion.

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been originally introduced into the stud farm at Hissar, and thence disseminated throughout the Punjab and Sind. The evidence collected in the Punjab would go to show that the disease is, and has been, a common and destructive one. . . . It appears, as a rule, in this country, to be more sporadic than epizoötic. *The general opinion appears to be that it is not contagious.* . . . The disease has not acquired that prominence or importance as a cause of sickness and loss of stock, which would suggest a trial of inoculation."

NATURE.

The exact nature of the malady, like that of Cattle-plague, is not perfectly known. Beyond the characteristics above enumerated, and the fact that it is a specific disease peculiar to cattle, we have little precise information. Though usually considered an inflammatory disease, one or two authorities are yet in doubt as to its being in any way connected with inflammation. Endeavours have been made to identify it with Rubeola and other human disorders, but with indifferent success; as there is little analogy between it and any special affection peculiar to mankind. In its essence, it is a malignant fever allied to the general eruptive diseases, generated by, and generating during its course, a specific virus which, when inoculated in a healthy animal, produces local and general disturbance, though very rarely the peculiar lung and pleural changes characteristic of the natural disease.

CAUSES.

The causes which lead to the production of this contagious disease are unknown; though a number of authorities believe that it may be originated directly under certain influences: such as too rapid fattening, excessive milking, and dwelling in hot damp stables, by which the animals contract a predisposition to its spontaneous development; these influences acting more energetically on strange cattle recently introduced than upon those which are accustomed to them. As external influences, a number have been invoked of the most diverse character: such as bad or improper, or sudden changes of food; too prolonged feeding on the residues of distilleries and breweries; marshy pastures; cold and damp; bad hygiène, &c. All these influences, however, were more or less in operation for centuries in this and other countries before the disease appeared, and they are present in regions in which the malady is yet unknown; so that to none, nor all of them, can we attribute the spontaneous origin of the disease. If it is developed in this way, it must be through a conjunction of complex causes of which we have no satisfactory knowledge at present. It has been pointed out that, as we sometimes

see the malady appear in localities in which there is no proof that strange cattle have been introduced, and that it prevails in countries which are quite isolated, the direct or spontaneous development of the disease cannot be denied. To this it may be answered that the history of the geographical extension of the disease is quite opposed to the theory of its spontaneous origin ; and that the traffic in cattle from disease-centres sufficiently accounts for its diffusion and persistency in those localities which are scourged by it. It follows the lines of cattle traffic, and its manifestations coincide with the introduction of imported animals.

SYMPTOMS.

Owing to the slow and insidious course of contagious Pleuro-pneumonia at its commencement, the few primary manifestations of its existence often escape observation: the animals appearing in their ordinary health, though the morbid changes may have made considerable progress. From this circumstance, the symptoms, for convenience of description, are usually grouped into two periods or stages ; the first relating to the chronic or developmental stage, and the second to the acute febrile period, in which the malady reaches its crisis.

1. *First Stage.*

This may continue from two to six weeks. The earliest indication is afforded by the thermometer, a rise in temperature preceding the other signs. Hence, when the malady appears in a herd, thermometry is of great value in enabling the expert to decide as to the animals which are infected, those which are actually diseased, and those which are yet in health. Under 100° they may be considered healthy ; but above that, and under 102°, they should be viewed as suspicious. Above 102° or 103° they are diseased. The first noticeable indication is a less keen appetite than usual, slower rumination, and the emission at rare intervals of a slight, weak, dry, and short cough of a peculiar and pathognomic character ; this is at first ordinarily heard in the morning after drinking, and when the animal rises or leaves its stable. Later, this cough is more frequent, dull, harsh, and painful ; and in

coughing the back is arched, and the head and neck extended. This symptom sometimes persists for weeks, and may be altogether overlooked, or reckoned of little moment. The respiration next becomes quickened (25 to 30, instead of 15 per minute) and gradually somewhat laboured: this change being accompanied by dilatation of the nostrils and heaving at the flanks. The hair loses its lustre and stands erect in places; the gums have a pale-lilac hue; the walls of the chest and the back, from the withers to the loins, are not unfrequently more sensible than usual to pressure, particularly in the costal interspaces; the appetite and secretion of milk diminishes; emaciation often sets in; a serous or sticky discharge takes place from the nostrils; and often, though not always, the pulse is quickened, and the temperature, especially at the ears and horns, is either heightened or liable to variations. If a physical examination be made of the chest at this period, it is usual to discover that a change in the pulmonary organs (in two-thirds of the cases the left lung especially) is going on, more particularly towards the lower third, increasing slowly in extent and intensity. This change is due to the air-cells becoming impermeable to the air, and alterations in the lining membrane of this cavity: in fact, we have the physical signs elicited by percussion and auscultation in Pneumonia and Pleurisy.

In many cases, this period is passed unobserved, or continues only for some days—depending, in all likelihood, on the condition of the animals and external influences. This is, so far as the safety of other cattle is concerned, the most dangerous stage; the insidious and apparently trifling symptoms being likely to throw people off their guard, and cause them to neglect preventive and repressive measures. Sometimes, again, death occurs during this stage, due to the debility brought about by extensive alterations in the lungs.

2. *Second Stage.*

At the termination of the first stage, the second suddenly ensues. This is marked by febrile phenomena of variable intensity, according to the extent of the morbid changes and

the irritability of the animals. The pulse is quickened to sixty or seventy beats per minute, and is tense; the heart's beats are indistinct, or bounding; the muffle is dry; the ears and horns are at times hot, at others cold, the temperature of the other parts of the body being frequently variable; there are sometimes slight shiverings; the appetite and rumination completely disappear; the fæces are rarely voided, and they are hard, and, like the urine, are dark-coloured; drinking is difficult, only small quantities being taken at a time, and the swallowing of these excites coughing; while the secretion of milk is nearly or entirely suppressed. The animals stand with their fore legs wide apart, often change the position of the hind ones, and seldom if ever lie down; when they do so, it is only for a short period, and they rest on the sternum, the limbs being doubled under the chest or extended in front. Progression is difficult and unsteady; the respiration is more hurried and laboured, with still greater expansion of the nostrils and beating of the flanks; moans and grunts accompany the respiratory movements, and in many instances the whole body shakes with the effort made to breathe.

The cough increases in frequency, huskiness, and painfulness, while pressure on the chest causes the animal to evince distress and to crouch and grunt; auscultation and percussion testify to extensive alterations in the lungs and the cavity of the thorax. At this advanced stage, death is generally the inevitable termination, and its approach is indicated by hurried and anxious breathing, the expired air being often fœtid; the cough is so frequent as to be almost continuous; the eyes and nostrils discharge a purulent fluid; the skin is dry, clings to the bones, and feels like parchment; the pulse is feeble, small, and extremely rapid, and the heart's beats tumultuous; the animal is unconscious, or regardless of what is passing around it; it is almost insensible to the infliction of pain, and can scarcely stand; œdema is perceptible in the region of the dewlap; when lying, it generally rests on its side, the neck extended, and the mouth open and discharging a viscid saliva; the mucous membranes become livid; loud groans are emitted; there is grinding of the teeth; the abdo-

men becomes distended with gas, and a fœtid diarrhœa setting in, the animal being in a state of extreme marasmus, death occurs in two or three weeks after this second stage of the disease has been reached; though asphyxia may terminate life at an earlier period.

COURSE AND TERMINATIONS.

As a rule, the disease is more rapid in its course as the animals are young, vigorous, and in good condition; those which are old, weak, or sickly, lingering longer. The duration of the malady varies according to the promptness with which the febrile symptoms supervene; should these be late in appearing, it may continue for several months.

In the first period, the malady at times terminates in perfect recovery; the cough becomes less frequent and gradually disappears, the difficulty in breathing ceases; and should the alterations in the lungs have attained a certain stage before the febrile period sets in, further changes may not take place, or partial recovery may ensue; but the normal condition of these organs is rarely regained.

In the febrile stage, recovery may also take place, though very seldom, and only in slight cases in which the lungs are not much altered. Then the fever and disturbed respiration diminish; the cough becomes stronger, and is usually accompanied by an abundant discharge of muco-purulent matter, which is a long time in disappearing.

An incomplete is more frequent than a perfect recovery. This is evidenced by a more or less frequent cough and persistent dyspnœa, due to the alterations in the affected portions of the lungs, the presence of exudation in the chest, adhesions between the lungs and side of the chest, &c., or, which is more frequently the case, the animal does not thrive, nutrition is deranged, and the value of the convalescent is considerably lessened. This happens generally with animals in which the disease is not acute, or which are weak and phlegmatic. Convalescence is generally very tardy, and may extend over one, two, or three months, during which time the animal may be capable of infecting others.

During the course of the malady, when recovery does not take place in the early stage, progressive consolidation (hepatization) of one or both lungs, or portions of these, occurs, with increase of exudation and effusion, and in six, eight, ten, fifteen, or twenty days after the commencement, death takes place. It is very rare, indeed, that, after the malady has existed for eight or ten days, the symptoms each day becoming more developed, the lungs regain their natural condition, and the other changes disappear. Death, in the majority of cases, is caused either by the diminished, or complete suppression of the respiration, pulmonary gangrene, or anæmia.

PATHOLOGICAL ANATOMY.

The pathological anatomy of this malady, in the first stage, can only be observed in those animals which have been purposely or accidentally killed. In these, the interlobular cellular or connective tissue forming the pulmonary lobules is chiefly involved.* This tissue is congested and impregnated with yellow serum in different parts, but usually towards the centre of one or both lungs; it appears as wide, yellowish-white, œdematous bands, which are at times streaked with blood extravasations, the pulmonary air-cells usually containing a small quantity of serum that escapes from the surface of a section. In very exceptional instances, this serum is replaced by deposits of fibrine, which may also be apparent on the inner surface of the cells near or immediately beneath the pleura; this membrane appears dull and covered by a thin layer of fibrine, and the subpleural tissue is infiltrated. The pulmonary lobules are affected in various degrees: some are merely congested and brownish-red in colour, while others are of their natural hue and spongy in consistency. At a more advanced period, there is gradually deposited in the cellular tissue of

* This abundance of pulmonary cellular tissue gives the lungs of bovine animals, when inflamed, their peculiarly characteristic appearance. It is, besides, continuous with the sub-pleural connective tissue, and divides the lobules into different-sized masses, rendering these more or less independent of each other. Therefore it is that we may find some lobules more severely inflamed than others, or even quite healthy in the midst of inflammation.

the diseased lobules an exudation of coagulable lymph, which, with the slow but continuous formation of connective tissue, causes the intervening pulmonary trabeculæ to become thickened and firmer in texture: some of them attaining a breadth of three, four, or even more lines where several small lobules unite to form a larger one; while smaller lobules are separated by septa of one or two lines. In consequence of the hypertrophy of this intervesicular tissue, the congested pulmonary parenchyma is more or less compressed, often to such a degree that the air-cells are obliterated; at other times, the air-vesicles are densely packed with cells as in ordinary Pneumonia, constituting what is known as "red hepatization."

The diseased lung increases wonderfully in weight, attaining sometimes to twenty, and even to fifty or more pounds; it is resisting and solid, does not crepitate when incised, and sinks readily in water, of course; it is very œdematous, and on section presents a most characteristic marbled appearance. This special pathological feature is due to the deep-red or reddish-brown hue of the compressed or hepatized pulmonary lobes or lobules, surrounded by wide bands of a grayish or yellowish-red colour, and which are composed of the infiltrated or hypertrophied cellular tissue.

With this condition of the lung, there nearly always coexists a more or less intense degree of pleurisy—parietal and visceral. The pleuræ are covered by a solid fibrinous exudation of varying thickness and abundance; while the cavity of the chest contains a variable quantity of serous fluid, in which float masses of fibrine. The amount of this fluid appears to be in an inverse proportion to the thickness of the pleural exudat. The pericardium sometimes exhibits the same alterations.

It should be noted that the cellular tissue lying beneath the parietal pleura is rarely involved; so that if this membrane is stripped off the interior of the chest, the pectoral walls appear quite healthy. The butchers often do this in order to dispose of the flesh of diseased cattle as food; but the artifice is readily detected by an expert. The flesh is dark and harsh in appearance, the fat frequently yellow-tinged, and there is an absence of blood generally.

Not unfrequently the effusion and false membranes are considerably less in one pleural cavity than the other; for owing to the posterior mediastinum not being perforated as in solipeds, it may happen that one side of the chest is seriously diseased, while the other is but slightly, if at all, involved.

The bronchial tubes generally contain a quantity of frothy serum, and, in the majority of cases, the smaller bronchules are filled with a croupal exudation, the bronchial vessels of the diseased part being frequently obliterated by clots of fibrine; this exudat may extend into the larger tubes in the form of hollow tubular masses.

If the disease is slight and circumscribed, the exudation may be absorbed, and the compressed pulmonary cells recover their normal dimensions: in which case, though it is very rare, but little alteration or trace of disturbance can be perceived. Far more frequently, the neoplastic formation of connective tissue continues, the congestion becomes less intense because of the compression to which the vessels are exposed, the lobules become pale, and the exudation and certain portions of the new tissue undergo fatty, caseous, or calcareous degeneration.

In other instances, suppuration attacks the hypertrophied interstitial tissue, and detaches more or less considerable masses of the lung texture. On examination, these necrosed tissues are found completely isolated in the midst of a thick purulent fluid, which is contained within a cavity whose rigid walls are composed of the newly-formed connective tissue in process of retraction. These detached portions of lung in some instances are scarcely altered; in others they are decomposed and friable, have a repulsive odour, and produce gangrene in the adjoining tissues. Sometimes suppuration commences in the hepatized portions, the purulent foci unite to form an abscess, giving rise to large cavities filled with pus; or there may be several small abscesses separated from each other by thickened interlobular fibrous tissue, containing a fluid or inspissated pus.

The abscess may open into the chest, producing empyema;

or the pus may be partially absorbed, and purulent infection result.

In consequence of the pressure the bronchial vessels receive from the greatly hypertrophied connective tissue, necrosis often affects circumscribed infiltrated portions of the lungs, and these become detached and remain encysted, as it were, in the pulmonary parenchyma. This process may be also due to thrombus of the bronchial arteries. As a result of the progressive hypertrophy of the connective tissue, entire lobes of the pulmonary tissue are at times deprived of their functions, and submit to fibrous degeneration. The pulmonary arteries are also liable to thrombosis and embolism, which may produce gangrene. This is evidenced by the brownish-red or nearly black hue of the lobules, the cellular septa are thin and infiltrated with bloody serum, and the texture of the lung tissue is friable and easily torn, and exhales the fœtid odour of gangrene.

The blood, in the early stage of the malady, is usually viscid, thick, and coagulates promptly; towards its termination, when symptoms of asphyxia, and particularly of gangrene, become manifest, it is dark and fluid, and has lost its coagulability.

The stomach contains dry food, and its lining membrane, as well as that of the intestines, may exhibit patches of congestion or extravasation.

These pathological alterations may vary in different cases, and more especially at different outbreaks: for example, a greater amount of effusion will be observed in the pleural cavity in some epizoöties than in others. But notwithstanding these variations, the pathological anatomy of the malady is very distinctive and unmistakable.

DIAGNOSIS.

The peculiar dry cough and feverish symptoms in the first stage, as well as the physical indications furnished by an examination of the chest in this, as in the second stage, offer a certain aid in diagnosis. The cough is generally so distinctive,

that those who have had much experience of the malady can recognize it at once. The disease is distinguished from ordinary pneumonia by the insidiousness of its course, its incubative stage, its being uninfluenced to any notable extent by food, climate, exposure, bad hygiène, or modification of these; its not being affected by medical treatment; its great fatality; its obvious contagiousness and dissemination by movement of cattle; and its slow progress towards a fatal termination or imperfect recovery.

A necroscopical examination of the chest and its contents, also generally furnishes conclusive evidence of the presence or absence of the malady. The marbled appearance in section, and other characteristics of the pulmonary organs—particularly the exaggerated hypertrophy of the interlobular septa, with interstitial proliferation of the connective elements—the peculiar aspect of the croupous exudats in and upon the lungs and covering the pleuræ, and the enlarged lymphatic glands greatly distended with lymph, are all so many diagnostic guides, they not being observed in sporadic Pleuro-pneumonia. In the latter, the hepatization throughout is of the same age and degree; in the former, it is in different stages in the same lung. The evidence of contagion is also a sure diagnostic guide.

To avoid the serious results which might occur through an error in diagnosis, it is always advisable to isolate animals which exhibit the slightest symptoms of indisposition, because of the insidious character of the disease.

CONTAGIUM.

The infecting principle of the disease is fixed and volatile, and exists in its greatest intensity in the air expired by a sick animal, and also in the lymph-exudat. It is likewise present in the cutaneous emanations, and probably in the secretions and excretions, as well as in the blood. It is produced during the whole course of the malady, but is most abundant and virulent during the febrile stage. For a certain period after convalescence, animals may transmit the affection. The contagium is also present for some time after death. It is

said that an animal may infect others during from three to six months after recovery; and Ziegler, of Berne, Switzerland, says there is evidence to show that a recovered cow or ox may contaminate others twelve, and even fifteen months after the symptoms have disappeared.

The virus is variable in its volatility and potency, and the malady it produces is somewhat eccentric when it appears among a number of cattle: generally affecting only a small number at a time, and lingering for a long period in the herd. The air may convey it to a distance of from 50 to a 100, and in special circumstances, even from 200 to 300 feet, according to some authorities.

VITALITY OF THE VIRUS.

The tenacity of the contagium does not appear to be well ascertained; but from the evidence at hand, it is very probable that it may retain its activity for several months—three to six, if we are to credit good observers. Healthy cattle have become contaminated after being lodged in stables which were occupied by diseased ones three or four months previously. Hay soiled by sick cattle has induced the disease after a longer period; and pastures grazed upon three months before have infected healthy stock. The flesh of diseased animals has also conveyed the malady; and it is recorded that the contagion from cattle buried in the ground infected others fifty or sixty feet distant.

INFECTION.

Up to the present time, we have no satisfactory proof that any other than bovine animals will receive the infection of Lung-plague.* Breed does not afford any immunity, neither does age nor sex; though, as in other contagious diseases, all are not susceptible at a given period—15, 20, or even more per cent. escaping. Calves are not unfrequently affected.

* It has been reported that butchers and knackers, through accidental inoculation, when cutting up the carcasses of animals affected with contagious Pleuro-pneumonia, have subsequently suffered from as serious symptoms as those experienced by surgeons after dissection wounds.

As a rule, it is only what we may term the "volatile form" of the contagium which produces the Lung-plague. It is quite exceptional that what we have designated the "fixed form," when inoculated, gives rise to the special pulmonary and pleural alterations described as pathognomonic of the malady. There is no proof that the nasal mucus, saliva, &c., when rubbed into the mucous membranes of healthy animals, will produce the disease, neither will the transfusion of blood from the diseased cattle.

MODE OF INFECTION.

Infection may occur through contact of healthy with diseased animals, on roads, railways, ships, pastures, stables, &c., and through the medium of forage, straw, &c., which have been soiled and breathed upon by infected cattle, the utensils which have been used with them, as well as persons who have attended to the sick. The atmosphere may likewise, as has been observed, convey the virus.

MODE OF ACCESS.

There is every probability that the contagium of the Lung-plague must find its way to the system by the respiratory passages in order to produce the peculiar lesions in the pulmonary organs and thorax. Inoculation in various parts of the body with the lung-serum certainly gives rise to local and general disturbance, often of a very serious character; but it does not, as a rule, bring about those alterations in the thoracic cavity which are looked upon as constituting the essence of the disease. It is, therefore, not unlikely that the virus is conveyed into the lungs in the act of inspiration, and, localizing itself in these organs and their investing membrane, develops those morbid processes which prove, in the majority of cases, so destructive.

It is not probable that the virus obtains access by the digestive organs. Experiments with a view to test this were made at Alfort, in 1868 and 1869. Portions of diseased lung and several pints of the effused serum have been administered to healthy cattle without producing any result.

INCUBATION.

The incubatory period of this disease is rather variable. In the larger number of instances, there is an interval of from three to six weeks, or two months, from the reception of the contagium to the primary manifestations of the affection. Exceptionally, it may only extend from eight to fourteen days, or from ten to sixteen weeks, and some observations would even go to prove that a period of nine to ten months may elapse before the disease shows itself.* It must be remembered, however, that as inoculation cannot be resorted to with certainty (so far as the thoracic lesions are concerned) for the production of this lung affection, we have only casual observations to guide us in ascertaining the latent period.

EXTENSION.

The extension of the Lung-plague is due to its contagious properties. If it prevails in any part of a country, it will extend thence on every side as from a centre, provided the conveyance of the virulent principle is possible. Whenever it appears, it spreads in proportion to the opportunities for transmission; and its comparatively long period of incubation and duration, with the very tardy convalescence of the animals which recover, and during which they are still dangerous as generators of infection, renders its conveyance to immense distances perfectly possible. The great increase in cattle traffic, and the manifold facilities afforded by railways and steam-ships, have not only carried it to the most remote regions of the globe, but they have also largely multiplied the centres of infection, and thus augmented indefinitely the number of infected localities.

The extension of the disease, then, depends upon the cattle

* In this country, the "Contagious Diseases (Animals) Act" only admits a period of thirty days; and as, after this time, isolated animals are allowed to be moved and to mix with others, we need not be surprised to find numerous outbreaks among them, and among the cattle with which they have subsequently been mixed. The period of isolation is too short to be effective.

traffic from disease-centres, and the direction of its diffusion upon the lines of this traffic. It is, nevertheless, a fact that the malady, like some other diseases of this class, often prevails on a large scale for a number of years, and subsequently subsides to smaller proportions, these exacerbations or recrudescences not depending upon any appreciable cause.*

Its extension is also slow and insidious in large collections of cattle. For instance, if it appears in a stable or herd, at first one or more animals will be attacked; several weeks afterwards, some others will fall sick, and after another interval two or three more will become affected, and so on; the disease thus maintaining itself among them for a long period. More particularly is this the case if new stock is introduced to make up for others sold or dead from the malady, as constantly happens; in this way the scourge is fed, and becomes domiciled. In large cities we have a striking example of the ravages produced from this mode of extension.

In winter, when the cattle are confined to stables, and but little communication with other herds takes place, the malady

* This is shown in the statistics of the malady in Prussia, as collected by Roloff (*Zeitschrift für praktische Veterinær. Wissenschaften*, 1873), wherein we see the number of circles or districts in which, year after year, the disease has prevailed :—

Years	1851	1852	1853	1854	1855
Number of infected districts	64	66	51	54	65
Years	1856	1857	1858	1859	1860
Number of infected districts	63	59	37	33	34
Years	1861	1862	1863	1864	1865
Number of infected districts	43	46	52	41	40
Years	1866	1867	1868	1869	1870
Number of infected districts	54	52	49	50	48

Roloff remarks that the farmers endeavour to conceal the existence of the malady (doubtless because there is no compensation for slaughtered animals). In each of the circles indicated, there are always several infected communes. In the Province of Saxony (Prussia), there are certain circles which have been infected for a number of years, and there are farms in which the disease has been stationary for a long time; these are large farms, where the damage caused by the scourge is all the more serious.

diminishes in severity ; but in the fine weather, when grazing commences and different herds meet, if there is a diseased animal among them it soon spreads. A suspension of cattle traffic and movement in an infected country quickly reduces the number of attacks, and isolated herds in such a region may entirely escape the plague. Calves are often affected, and become carriers of the contagion. Many indisputable cases are on record.

MORTALITY AND LOSS.

From the insidiousness, and long incubation and duration of the malady, the mortality accompanying it is not so striking as in such a disease as the Cattle-plague. Nevertheless, it is a very destructive and harassing disorder, and has, there can be no doubt, inflicted a greater amount of loss and embarrassment during this century than that scourge. The mortality varies ; and it may be accepted as a rule that, when introduced into a new country, or one from which it has been absent for a long time, it is more destructive than in one in which it has become domiciled, or from which it has only disappeared for a brief space.

The deaths resulting from the disease may be estimated at from 15 to 20, and even as many as 70 per cent. In mild invasions, they may only be 20 or 25 per cent., but in those of a severe character, they may amount to 70, 80, or 90 per cent. In general, however, the loss from death, and from animals slaughtered or disposed of on account of the disease, may be estimated at about 60 per cent. This, nevertheless, does not represent all the harm wrought by the Lung-plague. What with the long duration of the malady, the slow and protracted convalescence, the consecutive disorders, perhaps permanent loss of condition, the expense of medical treatment, the non-productiveness of the animals for months, &c.—all this makes contagious Pleuro-pneumonia one of the most disastrous plagues that can afflict a cattle-producing country.

The truth of this may be easily verified in the history and literature of the malady, particularly in England and Holland :

two countries in which it had been allowed to extend and prevail for many years without any reasonable attempts at suppression. In our own country, the loss in six years has been estimated at a million head ; while in Holland, in 230 parishes, the yearly loss has been reckoned by Sauberg at 49,661. In Wurtemberg, in ten years, the disease appeared in 705 parishes, and affected 1706 stables containing 10,214 cattle. Of the latter, 4200 (or 41 per cent.) became diseased, and 6014 (or 59 per cent.) remained unaffected. Of the sick, 1,617 (or 39 per cent.) recovered, and 2583 (or 61 per cent.) were killed or died of the malady.

In France, the disease has caused great losses, chiefly in the Northern departments, where there is more importation and movement of cattle, owing to the facility with which they can be fed on the residues from the distilleries and sugar refineries. According to the statistics of the losses caused during seven consecutive years, in 217 communes of the department of the Nord, it would appear that the annual mortality in a bovine population of 280,000 was 11,200, or a total in nineteen years of 218,000 head ; whose value Reynal estimates as amounting to about no less than fifty-two millions of francs. The statistics collected by Yvart during his inquiries in the departments of Aveyron, Cantal and Lozère, show an even greater sacrifice ; as several proprietors acknowledge having lost 30, 40, 50, 68, and even 77 per cent. The average for the three departments was not less than 35 per cent.

In Australia, the losses caused by it during the thirteen years it has prevailed there (for it did not spread to any great extent till 1860) cannot be estimated at less than 30 to 40 per cent. of the whole number of cattle, or about 1,404,097 head ; which if valued at only £6 each, would amount to about £8,500,000 through this disease alone.

In this country, since its introduction, we can form but a very imperfect notion of the serious destruction wrought by the disease. It must have been enormous. Gamgee, for Edinburgh only, estimated the annual loss as equivalent, in money value, to £200,375. For the six years ending with 1860, it has been calculated that there perished considerably more

than a million of cattle in the United Kingdom, the value of which must have amounted to at least twelve million pounds. And my respected teacher, Finlay Dun, in drawing the attention of the Scottish Chamber of Agriculture to the lesson afforded by the statistics of an English Cattle Insurance Company, points out that from 1863 to 1866, the death-rate from this scourge was from 50 to 63 per cent. annually. During the Cattle-plague invasion, when cattle traffic was suspended, it fell to one per cent., this rate it maintained until the traffic was resumed towards the end of 1867, when, during the first seven months, the mortality from Pleuro-pneumonia sprang up to 30 per cent.

IMMUNITY.

Animals which have perfectly recovered from the Lung-plague are refractory, for a time at least, to another attack. The period of immunity is considerable, and some observers even maintain that it continues during life. This is extremely probable. The immunity which some animals naturally enjoy, when brought into contact with diseased cattle, is sometimes very striking; the statistics of the French and Belgian Commissions show that only from 35 to 68 per cent. of healthy cattle become diseased when the contagion is introduced among them.

SANITARY MEASURES.

The sanitary measures to be employed to combat this disease should be similar to those for the Cattle-plague, and must be based on a knowledge of the character of the malady, its period of incubation, and the manner in which the contagion is transmitted, as well as the channels by which it is extended. All of these, except the last, have been already described.

The aim, then, of these measures, is to prevent the transmission of the disease to animals of the bovine species in a country in which it has not yet appeared, and to eradicate it in localities where it has already manifested itself.

PERMANENT PRECAUTIONARY MEASURES AGAINST INVASION.

To prevent the introduction of the disease from countries in which it prevails, or is frequent, into another where it is unknown, requires the same frontier or sea-port precautions as have been enumerated for the Cattle-plague.

The most scrupulous vigilance must be exercised with regard to the health of the animals imported from these countries, if this importation cannot be dispensed with; they should only, if possible, be drawn from the localities which are free from the disease; and some days before exportation, they ought to be inspected by a competent and responsible veterinary surgeon, whose health certificate should accompany them. If fat stock, at the place of importation they should be again carefully inspected; and should there be nothing suspicious (always remembering the period of incubation for this disease), if not slaughtered at the abbatoir belonging to this place, then they may be sent to the foreign inland markets; or, better still, be forwarded to their destination for immediate slaughter.

If lean stock, then greater precautions should be observed before they are allowed to circulate through the country. It would be well to impose a period of quarantine of at least three weeks to two months' duration, if there is the slightest suspicion as to their health; and should the disease appear in any of them during this interval, all should be sacrificed. The greatest care should be exercised in obtaining these animals from uninfected localities of the scheduled countries, and dealing only with well-known merchants. Warning should be given to all who traffic in, or purchase cattle, of the risks they incur. The railway waggons and steamboats conveying cattle from countries known to be infected should be thoroughly cleansed, dried, and disinfected after landing each cargo, and an abundance of fresh air should be allowed on the main deck.

PROVISIONAL MEASURES.

PREVENTIVE MEASURES.

When the disease has invaded a country, the cattle-owning inhabitants therein should be informed, by placards and otherwise, of the existence of the disease, its nature, symptoms and contagious character, and the only efficacious means of guarding against or suppressing it.

The railway and boat-traffic, and cattle-markets and fairs should be closely watched, as well as the movements of unscrupulous butchers aud petty cattle-dealers. There are those of the latter class who make a regular trade in diseased cattle, and are mainly instrumental in disseminating the contagion.

All animals found to be diseased should be killed on the spot, and buried with due precautions ; and animals suspected because of contact with these, may be sequestrated for the full period, or killed on the farm and sold as food.

The purchase of new stock cannot be too carefully conducted ; and unless the previous history of the animals is well known, and no suspicion attaches to them, they should be kept apārt from other stock for from three to eight weeks. This "home quarantine" is an excellent measure, and, if carried out with due circumspection, cannot fail to be productive of the best results, as the majority of outbreaks are due to the introduction of fresh stock. Every farmer or cattle-owner who requires to purchase new stock, should have a quarantine stable in which to isolate strange cattle until a sufficient period has elapsed ; and though the incubatory stage of the malady is protracted, yet even during the shortest quarantine period just specified, there is every probability that among a number of animals one or two would, if infected, manifest symptoms of the malady before its expiration.

It would be well to ascertain where the cattle came from before purchasing them, the reasons for their being sold, and also the character of the person offering them for sale.* It

* This precaution is indeed urgently necessary ; as nothing is more common than for a cattle-owner, when the disease appears among his stock, to

might even be judicious to institute warranties for other than fat stock, so as to ensure freedom from this disease ; the period covered by the warranty extending to at least forty days. This would abolish fraud and discreditable practices.

SUPPRESSIVE MEASURES.

When the disease appears in a herd or on a farm, the most active measures should be adopted for its prompt extinction.

The owner should be compelled to declare its existence as soon as discovered ; the proper authorities, being duly warned, will take the necessary steps. Any person concealing the existence of the malady, and disposing of the infected animals, should be severely punished, and even compelled to make good the damage his dishonesty may cause.

The existence of the disease should be published in the locality, in order to warn those whose cattle are endangered to take precautions.

Until the authorities have taken action in suppressing the disease, the owner should keep the infected stock away from all other cattle, and adopt every means in his power to prevent the extension of the contagion.

The authorities should isolate the farm, pasture, or shed ; and no cattle should be allowed to pass out or in.

The diseased should be removed from the healthy, and the suspected also from the latter ; the three classes being kept separate, and placed under the care of special attendants.

With regard to the diseased, considering the hopelessness of curative treatment and the loss thereby incurred, as well as the danger of spreading the infection, it will be most profitable and least onerous to resort to slaughter. Those least diseased and in good condition, should certainly be slaughtered and sold as food ; the head, trachea, lungs, and chest being buried. The slaughter should take place on the spot. Those which

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send them all to the market to be sold, no matter to whom. In this way the infected cattle, spread about in all directions, become, each of them, a new centre for the spread of the disease.

have apparently recovered ought not to be allowed to mix with healthy stock for a long time.

With regard to the suspected or infected, if in good condition they may also be slaughtered; if not, they must be kept isolated for three months from the date of the last case of disease. On no account should they be sold, except for immediate slaughter; and the authorities must take care that this measure is carried out.

The healthy must also be kept in quarantine for a certain period; and it may even be necessary to treat them as suspected, until all danger has passed away.

Considering the great inconvenience of isolation for such a long time, the measure is a severe one; but it is necessitated by the extreme seriousness of the disease, and the subtlety of its infecting principle. Scarcely any pains are too great to suppress such a plague; and when it appears on a farm or in a locality, great sacrifices must be made to extinguish it on the spot.

The question of compensation has not been entered into here, having been discussed in the second part of this work; but there can scarcely be any doubt as to the propriety and justice of indemnifying owners for the sacrifices they may have to make for the public good, and when these sacrifices will tend to check an outbreak of the disease in a locality hitherto free from it. It may be necessary to destroy the whole of the stock on a farm with this object; and the proprietor might certainly claim to be remunerated for his loss, provided always that the disease was not introduced by his own imprudence or neglect, and he had not endeavoured to conceal its existence. If destruction of the diseased and suspected be rendered compulsory, then compensation in full, in cases where every care has been taken to avoid the contagion, should not be withheld.

When the stables have been cleared of the diseased and suspected, or while the latter are isolated, these buildings, as well as all the articles used therein, should be scrupulously cleansed and disinfected, according to the instructions laid down. Washes of quick-lime should be frequently applied to

the walls and the wood-work, after chlorine or sulphurous acid disinfection; and the doors and windows should be thrown open for a long time, if the stables are empty. They should not be again occupied by cattle for two, three, or more months, unless the disinfection has been proved to be thorough.

The litter, forage, &c., in use in these places should be burned or deeply interred, or mixed with quick-lime and allowed to decompose in isolated places; and in bad cases of disease, when the carcasses are buried, the skins should be slashed and buried with them. If they are preserved, they should be treated as we have recommended in Cattle-plague.*

* The law passed by the Swiss Confederation, dated February 8, 1872, appears to have proved most successful in suppressing the disease, which, in a country like Switzerland, whose chief wealth is in cattle, must be a serious matter. This law ordains that animals which have been attacked with contagious Pleuro-pneumonia must not be sold; and that diseased cattle, as well as those which have been in contact with them, either in the stable or at pasture, are to be slaughtered. The cantonal medical authority may, however, in prescribing the necessary precautionary measures, permit curative measures to be tried.

The animals which have recovered are not to be sold, but ought to be slaughtered. The infected stables remain in sequestration for from four to twelve weeks; and the cattle in the neighbouring stables, as well as those which have frequented the same watering places as the diseased, or been otherwise in contact with them, must be under the surveillance of the police for twelve weeks. In the infected locality, the traffic in cattle, with the exception of those which are to be immediately slaughtered, will be suspended for four to twelve weeks subsequent to the disappearance of the malady.

If, in a locality or a country, the disease has become much extended, suspected animals may, under the superintendence of the police, be killed for food.

The stables, as well as the infected utensils, should be properly disinfected.

The severity of the measures to be adopted against the introduction of foreign cattle, will depend upon the nature of the measures in force in the country whence they come.

If, in a neighbouring country, contagious Pleuro-pneumonia prevails on the frontier, or if it appears in such conditions that Switzerland is threatened with its introduction, the importation of cattle from that country will not be allowed unless the animals are accompanied by a certificate granted at least six days previously, stating that they are in good health.

PROTECTIVE MEASURES.

INOCULATION.

As a means of abridging the duration of the epizoöty and averting the dangers attending the development of the disease by natural contagion, Willems, of Hasselt (Belgium), in 1852,

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If the cattle allowed to enter on those conditions remain in the country, they cannot be sold except for slaughter until six weeks have elapsed, and then only after they have been inspected by a veterinary surgeon.

If the measures adopted with regard to the infected country are insufficient, and if the health certificates are untrustworthy, recourse will be had to more severe measures; and if, in an adjoining country, this disease is notably propagated, the importation of cattle from it shall be completely interdicted.

The efficacy of these measures was demonstrated in a very short time; as, from the 31st of March to the 16th of April, no case of the disease had been reported in the whole confederation.

The select committee appointed to inquire into the operation of the Contagious Diseases (Animals) Act in Britain, report with regard to Pleuro-pneumonia:—

"(*a*). That the slaughter of all cattle affected with this disease should be compulsory, and that there should be compensation for cattle so slaughtered.

"(*b*). That the Rules in the 7th Schedule of the English Act should be so altered as to provide that cattle which have been in the same shed, or which have been herded with diseased animals, may be moved under regulations for isolation for two months.

"(*c*). That the power given by Section 54 of the English Act to an inspector to apply the Pleuro-pneumonia rules to any premises in which he finds that disease to exist, should be extended to any premises in which he finds that it has existed within 28 days.

"(*d*). That the time during which the Pleuro-pneumonia rules should be applied to any premises in which the disease has been discovered should be extended from 30 days to two months."

An Order of Council, cited as the Animals (Amendment) Order of 1873, was subsequently issued, and promulgated to take effect from the 31st of August, with reference to this disease; in this it is ordained that "every local authority shall cause all cattle affected with Pleuro-pneumonia within their district to be slaughtered. The provisions number (1), (2), and (3) of Article 31, and Articles 32, 33, and 34, relating to compensation, of The Animals Order of 1871, shall have effect in case of slaughter under this Article of this Order."

proposed the inoculation of cattle exposed to contamination, but which, on careful examination, were found to be yet free from the disease. For some years, the results of his experiments were received with discredit or doubt, and the value of inoculation as a preservative or prophylactic measure was negatived by a large majority of veterinarians. It is probable that this was due to the insufficient observation and experience of these authorities, as well as to the fact that inoculation does not produce the characteristic morbid processes that mark the progress of the disease itself; and hence it was contended that animals could not be so protected.

Nevertheless, for a long time the benefits to be obtained from this measure have been abundantly illustrated in those countries in which, it may be said, the malady prevails almost continually: as in Belgium, Holland, Northern Italy, the Southern Tyrol, and North Germany. France has also, in the opinions of the eminent veterinarians—Bouley and Reynal—advocated a recourse to the operation: the immense utility of which has been so fully recognized by the farmers and cattle-breeders of that country, that it is now generally adopted by them.

Authorities on whose statements the most perfect reliance can be placed, assert that since the adoption of preventive inoculation, the districts and farms in those countries in which the Lung-plague permanently prevailed, are now completely delivered from the scourge; and that it is excessively rare for an inoculated animal to be attacked with the disease—the percentage being less than one, and rarely not more than two. In South Africa and the United States of America, as well as in Australia, the measure has also been adopted with great benefit, though the operation has not always been properly performed. In Great Britain, it has scarcely been tried: an unwarrantable prejudice having apparently been raised against it when it was first proposed.

Official commissions have been instituted in Belgium, France, the several German States, in Holland, Italy, and other countries, and the conclusions of the majority of these have been favourable to preventive inoculation; the few who have

pronounced unfavourably, drawing their conclusions either from very few or doubtful cases, or acting in a very partial spirit.*

* Theoretically, as Reynal remarks, every analogy is in favour of inoculation for Pleuro-pneumonia. We have stated that one attack of the disease gives the animal immunity for life, but that it cannot be communicated by inoculation; at least the peculiar alterations in the respiratory organs cannot be so induced. Nevertheless, inoculation always produces, according to the most conscientious and impartial observers, and before the local phenomena appear, more or less intense febrile disturbance; the local effects being frequently accompanied by similar results in other parts of the body, and the subcutaneous cellular tissue being equally involved. This fact has lent much support to the opinions held with regard to the efficacy of inoculation. And the alterations produced at the seat of inoculation present absolutely the same fundamental modifications in the connective tissue as in the texture of the lungs; we have the same citron-coloured exudation, at times tuberculous elements, and also an excessive proliferation of the fibro-plastic elements.

With regard to the identity of the inoculated with the natural disease, Reynal mentions an instance in which a Breton heifer inoculated by him communicated the malady to two others standing beside it, in a stable of the Alfort School. The characteristic changes were found in the lungs of both after death.

That this inoculated malady is contagious, has likewise been proved by the observations of Voigtlænder and Lenhardt in Germany. Voigtlænder's observations on the similarity, or identity, of the natural and artificially induced disease are very valuable. He points out that when inoculation has been performed in the connective tissue, if the tumefaction which supervenes is examined, there will first be noticed the effusion, into the intercellular spaces, of a yellow serosity which gradually fills them. At the same time, and as the disease extends, the connective tissue becomes engorged and thickened; so that, in making a section of the part, its cellular arrangement can be distinctly made out, and there can be seen streaks or layers more or less thickened, and prolonged into the muscles, tendons, adipose tissue, and the skin. And when the tumefaction becomes extreme, the infiltrated and thickened connective tissue causes compression of the muscles and blood-vessels of the part, and this causes obstruction to, and even arrest of, the circulation. If a transverse section of a muscle be made in the tumefied region, there will be observed this thick and infiltrated connective tissue extending into the muscular fasciculi; and in the diseased subcutaneous space, we have, in miniature, a reproduction of the marbled appearance of the Pleuro-pneumonic lung. If the tissues of the inoculated region are examined microscopically, there are readily discovered in the effused serosity a great number of nucleated cells, and nucleoli whose dimensions

1. *Advantages.*

The advantages resulting from inoculation for this disease are very great; as it has now been proved by those who have had most experience, to be the quickest, most certain, and least expensive means of extinguishing it. The disease is within from four to six weeks abolished, and the animals successfully inoculated are no longer susceptible of the contagium, if not for life, at least for a long period. The operation is simple, and as the contagium is generally in a fixed form, there is not much danger of healthy animals being infected naturally, provided care is taken. The loss incurred is exceedingly small, if the operation is properly performed in a suitable part of the body.

2. *Disadvantages.*

The disadvantages are mainly those due to imperfect or improper inoculation by inexperienced persons. It has been said that the inoculated disease is contagious, and the instances we have quoted would go to prove that it is so, and

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are four times greater than the blood gobules; they grow quickly, and by their union constitute the mass which thickens the connective tissue. It is by these agglomerated cells that the tumour acquires its consistency and hardness. In the muscles, it is found that the primary fasciculi gradually lose their transverse striæ, and the sarcolemma becomes filled by a granular mass; while that sheath, which is all but imperceptible in a healthy condition, is now very distinct, owing to the thickening it undergoes at the same time as the connective tissue. Even in the masses of adipose tissue, there is noted this hypertrophy of the connective tissue.

In comparing the lesions in the inoculated region with those of the diseased lung, there is every similarity between the two. The alterations in each follow the same course; at first effusion of serum, then thickening of the connective tissue by the deposition of cells of a new formation, and, later, a plastic exudation of coagulable fibrin, which unites the primitive connective tissue and the pathological tissue formed by the cells. Whoever examines the alteration in the inoculated region, will find the analogy between them and those of the diseased lung so striking, that he will no longer be able to doubt the important fact, that by the inoculation with the virulent fluid the malady has only been transferred to another part of the body. In this way we can explain how it is possible that inoculated animals communicate the disease to healthy cattle. — *Der Pathologische Prozers an der Impfstelle bei der Lungenseuche*, 1865.

testifies to the necessity there exists for keeping recently inoculated animals apart from those not yet inoculated.

3. *Loss.*

The losses from this operation, if performed skilfully and with due precautions, are infinitesimal when compared with those occasioned by the disease. They have been variously estimated by different authorities. Gamgee states that in two thousand instances in which he operated, the loss was less than one per cent.; Haubner of Dresden gives it as one to two per cent., but when the inoculations have been made at the dewlap, as five to eight per cent. When the tip of the tail has been the seat of inoculation, the loss of the end of that organ has occurred in five to ten per cent. of his cases; but they were under five per cent. in Gamgee's.

The annexed table, drawn up by Reynal, will afford an idea as to the value of inoculation.* It must be remembered that

* In every country where this protective measure has been fairly tried, even when very improperly performed, there is the most striking evidence as to its value. Take Australia, for example. From the answers received by stockowners, it was found (1) that in almost every instance in which inoculation was properly tried, the disease disappeared from the herd, in a shorter or longer period, according to the size of the herd, but always before *three months* from the date of inoculation; (2) that while the disease thus disappeared in a short time from the herds which were properly inoculated, it continued in those which were not inoculated for periods of from *two to six years*, according to the size of the herd; (3) that cattle which had been properly inoculated when sound, with a few solitary exceptions, never afterwards became diseased, although they were frequently mixed, and sometimes even put in the same paddock, with uninoculated cattle which were dying of the disease; (4) that where the right kind of virus was employed, the operation properly performed, and the weather not too hot, the deaths from inoculation never exceeded more than two, and seldom more than one per cent.

A striking instance of the value of inoculation is given by Ulrich of Breslau, a very distinguished veterinarian, in the *Magazin für Thierheilkunde* for 1872. In 1867 the disease broke out in the sheds of a sugar refinery in which stood eighty cattle, whose average value was 300 francs each. Eight of these were sold as diseased to the butcher for 150 francs —or a loss of 50 per cent., and the owner was about to have the remaining seventy-two disposed of in the same manner, at the same rate, when Ulrich

the mortality from the disease incurred in a natural manner is at least thirty-five per cent.

PROPHYLACTIC INOCULATION.

When a country or a district is threatened with an invasion of Lung-plague, prophylactic inoculation may in certain circumstances be advantageously resorted to.

COMPULSORY INOCULATION.

As a rule, inoculation should only be practised when there is the most urgent necessity for it; as when the Lung-plague has invaded a herd, and one or two animals are already suffering from it; or when the disease prevails more or less generally in a country or district, and isolation cannot be practised, or new purchases are being constantly introduced among the herd. It may, however, happen that, as a preventive measure, when the disease threatens to invade a country, recourse to it will be necessary, and especially if the introduction of the contagion cannot be averted.

INOCULATION VIRUS.

The selection of a proper quality of virus has much to do with the success of the operation. To procure this it is necessary to kill an animal in the early or febrile stage of a mild attack, when the interlobular texture of the lung is filled with a yellow, thick serosity that remains fluid so long as the pulmonary tissue is warm, but separates into a clot and liquid portion when cold. Consolidated, dark-red, or gangrenous lung is not to be recommended as the source of the inoculation

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proposed inoculation. This measure was adopted, and though six afterwards died of the disease, having been, no doubt, infected when the operation was performed, the other sixty-six were preserved. Ulrich has quite recently informed me that more striking evidence of the value of inoculation has since been collected by him, and that he entertains no doubt whatever as to the efficacy of this measure.

GENERAL TABLE OF THE INOCULATIONS PRACTISED FOR CONTAGIOUS PLEURO-PNEUMONIA IN EUROPE.

Countries.	Animals Inoculated.	Previous Condition of the Animals.					Result of Inoculation.							Accidents.			Sick after Inoculation.	Re-inoculations			
		Healthy Stables.	Animals exposed to Contagion.	Animals previously Sick.	Animals sick when Inoculated.	Animals of which nothing is known.	Inoculations, the result of which is unknown.	Inoculations, the result of which is known.						Loss of the Tail.	Gangrenous Swellings.	Deaths.		Animals Re-inoculated.	Symptoms.		
								No symptoms.	Healthy Animals.	Symptoms.									Previously unsuccessfully Inoc.	Previously successfully Inoc.	Doubtful previous successful Inoculation.
										Exposed to Contagion.	No Information.	Sick before Inoculation.	Sick at the time of Inoculation.								
Belgium	35137	2556	12045	2	19	20515	25974	1540	2056	2798	2767	„	4	682	22	237	540	77	71	1	5
France	6091	229	4472	„	15	1375	3910	523	59	1586	8	„	5	524	10	79	78	76	76	„	„
Holland	13933	345	4690	1	1	8896	8878	2119	292	2388	3344	„	„	229	2	73	1012	„	„	„	„
Prussia	3176	39	1033	6	3	2095	1993	439	38	482	215	6	3	60	„	50	438	64	64	45	„
Italy	2274	56	945	5	32	1236	1983	66	„	24	200	„	1	50	18	37	66	60	60	„	„
Germany, Austria, England	1749	„	1362	6	14	361	362	789	„	385	195	6	12	37	1	14	90	„	„	„	„
Totals	62360	3225	24547	20	84	34478	43100	5476	2445	7663	6279	12	25	1582	53	490	2224	277	271	46	5

virus. To obtain it from a lung in the first stage of the disease, the organ (fresh) is placed on a strainer over a glass or other vessel, and incisions are made in it, from which the serum flows. To expedite this flow, warmth may be applied by means of hot water or a sand-bath, and every care should be taken to prevent putridity in the transparent citron-coloured fluid collected in this manner. It is best kept in hermetically-sealed tubes, and the slightest evidence of approaching putridity (evidenced by the presence of bacteria in the fluid) should be sufficient to condemn it as unfit for inoculating.

PRECAUTIONS TO BE OBSERVED.

Inoculation may be safely resorted to under almost any circumstances, provided cleanliness is maintained. No matter how the cattle are managed, the condition they may be in, or the season of the year, provided the operation is properly performed, there are scarcely any precautions to be observed. The cattle should, if possible, be kept on dry ground; or in sheds, the floors of which are covered with straw or saw-dust.

THE OPERATION.

Cattle have generally been inoculated in one of two regions: either in the dewlap or the tail; but in the former the losses have been much greater than with the latter. Indeed, it has been found that in all those parts of the body where the skin is loose, and cellular tissue abundant, there is danger to be apprehended from inoculation. The root of the tail and the lip have been tried, but there also serious consequences have followed; and now the tip of the ear or tail is proved to be the safest part to operate upon. The ear, however, offers disadvantages which the tail does not; and therefore the balance of opinion is in favour of the end of the tail, either on its anterior or posterior surface—usually the latter.

A grooved needle or lancet may be used to insert the virus beneath the skin, but general preference has been given to

Sticker's needle. This consists of a hollow stylet, with a sharp diamond-shaped point. To the stylet is attached a little India-rubber tube, which is passed into a wooden handle furnished with a spring, by which the tube can be pressed in order to expel the air in it; when this is done, the point of the instrument is placed in the inoculation fluid, and, the spring being released, a small quantity is drawn into the instrument, sufficient for an inoculation.

The hair being removed from the part to be inoculated, the serosity is inserted beneath the skin by one or two, or even four, punctures, distant from each other at least two inches. Some inoculators introduce cotton threads impregnated with the virus, by means of a curved suture needle.

With the tubes proposed to preserve the liquid, a very simple plan consists in using a small bistoury or lancet, scarifying the upper surface of the tail an inch or so from the end, where the hair has been previously removed. The scarification must be superficial, and blood should not be drawn if possible. Both ends are broken off the tube; a little india-rubber ball or tube is fixed to one end, and by squeezing this, a few drops of the virus are pressed into the scarification. This, according to Gamgee, is the safest mode, as there is no doubt of the virus being applied to an absorbent surface; while the method of collection affords a guarantee of its purity.

CONSEQUENCES OF THE OPERATION.

The number of unsuccessful inoculations is about ten per cent. If successful, there elapses an interval which may vary from one to several weeks, but is generally from two to four weeks, or twelve to fourteen days. At the expiration of this period, there is an increase in temperature and sensibility at the part inoculated, with slight swelling; the skin also becomes highly coloured and less adherent to the parts beneath, and in a short time there is developed a hard hot tumour varying in size from that of a chestnut to a hen's egg. At the same time there is fever, sometimes shivering, slight loss of appetite,

breathing more difficult, and a short frequent cough.* The secretion of milk may also be diminished, and constipation may be present.

If the development of the tumour has been regular, it usually decreases gradually in size, the fever disappears, and recovery is rapid—in about fifteen days. It has even been stated that the animals successfully inoculated give more milk, and are more readily fattened than those which have not been operated upon.

If the animals are already affected with the disease, even in its earliest stage, inoculation often produces no effect; though there are numerous cases on record in which the operation appears to have checked the progress of the malady.

It may also be noted that when the development of the swelling has been as above described, the fluid that exudes from it may serve for other, or *secondary*, inoculations. These act with more rapidity and less intensity than the primary inoculations, though conferring equal immunity; the erysipelatous swellings at the inoculated part being inconsiderable.

ACCIDENTS FOLLOWING THE OPERATION.

The accidents succeeding inoculation are generally due to the manner in which the operation is performed, the seat of inoculation, and the character of the fluid inoculated. The accidents are most frequently gangrene of the part inoculated, considerable constitutional disturbance, and in some cases death. When inoculation has been practised on the tail, gangrene may cause the loss of the whole or a portion of this organ.

This accident generally occurs in from five to ten per cent. of the operations.

Secondary deposits or infiltrations may occur in other parts of the body than those inoculated, and extensive erysipelatous swellings may also appear. In some of these cases, if death

* Voigtlænder has particularly noticed this cough consequent on inoculation. He describes it as strong, deep, and frequent, and lasting for perhaps six weeks after inoculation, gradually disappearing of itself.

does not ensue, there is great general derangement of health and loss of condition. Sloughing of the whole or part of the tail must also be looked upon as a somewhat serious result of the operation, as it renders the animal unable to protect itself from the flies during the warm weather.

In the majority of these accidents, about twelve or fourteen days after inoculation, there appears a considerable amount of tumefaction around the inoculated spot, and which, in the course of twenty-four to forty-eight hours, extends to a variable distance, sometimes to the base of the tail, but in most cases to about eight to eighteen inches from the inoculation wound. The skin is then very inflamed, shining and tense, the hair is erect, and the movements of the tail are extremely painful ; the wound opens and shows a number of large granulations, while it discharges a yellow serum that sticks to the hair. There is slight fever. It is in these cases that the end of the tail frequently sloughs off, if it be not previously amputated.

There are cases in which the tumefaction extends farther, even to the base of the tail and the muscular parts ; in some instances the reaction is feeble at the inoculated part, and a large swelling appears towards the loins or croup, where at times an abscess forms. The reaction is always more serious when it sets in before the above-mentioned periods, and particularly towards the sixth day.

In addition to the causes already enumerated as influencing the production of these accidents, it has also been observed that the reaction following inoculation depends upon various influences to which the animals are submitted before or during the operation. Tubercular phthisis, for instance, according to the observations made at the Dresden Veterinary School, predisposes to those complications which usually involve loss of the tail. And during an epizoöty of rapid and very contagious Pleuro-pneumonia, inoculation is followed by a more energetic reaction than when the disease is slow in its course, and only makes victims from week to week. The ventilation of the cow-sheds, mode of feeding, &c., likewise influence the results of inoculation.

To prevent these accidents, it is well, in addition to taking the precautions already indicated, immediately after inoculation has been practised, to diminish the allowance of food, to see that the fæces do not soil the inoculated part, and to give saline purgatives. It is also necessary to prevent the tail having too much motion, by securing it to a surcingle fastened around the body. If the swelling becomes great and the skin very tense, in order to prevent gangrene or septic infection, cold should be continuously applied, either by means of a stream of cold water, or clay tempered with vinegar; when gangrene is imminent, scarifications or deep incisions should be made in the tumour, and the other measures necessary in the treatment of gangrene must be adopted. The animals should also be lodged in cool, airy stables.

CURATIVE MEASURES.

The medical treatment of contagious Pleuro-pneumonia is, in the majority of cases, unsatisfactory and unprofitable. Different methods have been resorted to and with varying results, some nevertheless being apparently more successful than others. Depletive measures are not to be recommended. Mineral astringents—such as the sulphate and sesquichloride of iron—and those obtained from the vegetable kingdom, are the best internal remedies in the earlier and later stages of the disease. Counter-irritants to the sides of the chest are also beneficial in certain cases; but care must be taken that they do not produce too much constitutional disturbance, and lead to debility and exhaustion. Inhalations of carbolic acid vapour, and the internal administration of that substance, have been favourably reported upon. Should constipation be present, purgative medicines may be resorted to with care.

Whatever treatment is adopted, it must not be forgotten that the sick animals must be rigidly isolated from those yet healthy, and persons told off to attend to them only. The places in which the patients are lodged should be kept at a moderate temperature, and supplied with plenty of fresh air, but there must be no draughts. The diet should be good, of

easy digestion, and given only in small quantities, though frequently. Disinfection ought to be resorted to.

The cases which offer most prospect of success in treatment, are those in which only one lung is involved ; left to nature even, many of these will recover ; whereas when both lungs are affected, a favourable result can rarely be anticipated.

Seeing the long period during which the diseased may infect others after recovery, and the risk attending keeping such animals alive, they should be fattened as quickly as possible and sent to the butcher, precautions being taken in the meantime.

THE FLESH OF DISEASED CATTLE AS FOOD.

Since the malady has been recognized, it may safely be asserted that the flesh of millions of diseased animals has been consumed as food in every part of the world, and yet there is not, to my knowledge, a single instance of any accident attending or following its use.* In this country, there has been a regular trade in cattle affected with contagious Pleuro-pneumonia, in which the butchers have been the principal agents ; and nothing has transpired to prove that the flesh of these animals was productive of bad results.

There can be no doubt, if the disease has made any marked progress before the animal is killed, that the flesh must be more or less depreciated in quality, and that its nutritive properties must be diminished ; but that it will produce any injurious effects if utilized as food, there is no evidence to prove. Loiset has pointed out that in the town of Lille, during a period of nineteen years, the flesh of 18,000 diseased cattle had been consumed, and that the sanitary condition of the people was unimpaired.

According to Reynal, it has for more than twenty years been sold daily in Paris and the North of France, without any

* Livingstone speaks of people and animals in South Africa perishing after consuming this flesh as food ; but he confounds the disease with Anthrax. Hence the error he commits in ascribing injurious properties to the flesh of animals which have died of Pleuro-pneumonia.

objection on the score of its unhealthiness to those who have consumed it. In this country it has been largely consumed since 1841, and nothing has been reported to its prejudice.

This innocuousness of the flesh of cattle which have been killed in consequence of being affected with the Lung-plague is a very important fact; as in permitting it, under proper supervision, to be used as food a great saving is effected, and two important ends are achieved: the public are not deprived of a portion of a most essential article of diet, and preventive or suppressive measures against the contagion are greatly facilitated, and rendered much less onerous.

There is, then, no reason to interdict the sale of such flesh as aliment, if care be exercised with regard to the extension of the disease to healthy cattle through this traffic.

Beyond the pathological appearances found in the cavity of the chest and the respiratory organs, there is nothing to indicate in the carcass of an animal which has even been affected to an extreme degree, that it has suffered from this disease. The flesh is in no ways different in appearance from that of a healthy ox in the same condition as regards fat, except that occasionally the muscular system may "look feverish."

So that there is no certain criterion to guide the sanitary inspector, unless the chest or its contents can be inspected. The condition of the lungs affords at once proof of the presence of the disease. If they have been removed, then a careful examination of the inner surface of the thorax will discover either the remains of false membranes, or testify to the attempts which have been made to remove them either by cutting, scraping, or dissecting off the covering pleura.

THE MILK OF DISEASED CATTLE AS FOOD.

As with the flesh, so with the milk obtained from diseased cattle; we have no evidence that its use as food has ever caused any injury to those consuming it. This milk is constantly sold, particularly in large towns, and physicians and veterinary surgeons have repeatedly testified to its harmless-

ness. Loiset, more particularly, has devoted his attention to this subject, and states that at the public abattoir of Lille, the *employés* of the cattle-dealers and salesmen have consumed the milk obtained from diseased cows for a large number of years, without the slightest inconvenience.

So far, then, as the public health is concerned, it appears to be fully established that neither by contact with Pleuro-pneumonic cattle, nor in the consumption of their flesh and milk as food, is any danger incurred by mankind.

FOOT-AND-MOUTH DISEASE.

SYNONYMS.—Technical: *Eczema epizoötica*, *Aphthis pecorinis*. English: *Epizoötic aphtha*, *Aphthous fever*, *Vesicular epizoötic*, *Murrain*, *Epizoötic eczema*. French: *Stomatite aphtheuse*, *Cocotte*, *Surlangue*, *Mal de bouche*, *Epizoötie aphtheuse*, *Phlycténée glosso-péde*, *Fièvre aphtheuse*, *Fièvre aphthongulaire*, *Exanthème interphalangé*, *Bouche chancrée*, *Bouche ulcérée*, *Muguet*, *Claudication*, &c. German: *Maul-und-Klauenseuche*, *Blasenausschlag*, *Blasen-oder-Aphthenscuche*, *Maulfaule*, *Sabberseuche*, *Blattern*, &c. Italian: *Alcolo*, *Fonzello*, *Afta epizoötica*, *Epizoözie aftose*, *Febbra aftosa*, *Ambolla*, *Mal di ambolla*, *Stomatite aftosa*, *Mal della bocca*, *Zoppina*. Bengalee: *Homsa*, *Khoorea*, *Khoorha*, *Khoraha*, *Mohpuccah*, *Khurpuccah*, *Mukhur*. In Thibet: *Khuchha*. Singhalese: *Kata ledé*, *Kura ledé*.

GEOGRAPHICAL DISTRIBUTION.

If we are to judge by the somewhat vague descriptions of different diseases given by the Roman and Greek writers, this has been a European malady for 2000 years. But no great amount of reliance can be placed on the accounts given by these authorities of many of the maladies they observed in animals, so far as their distinction goes. It is not until we reach the seventeenth and eighteenth centuries, that we can find reliable proofs as to its presence. Then it was noticed frequently prevailing widely in Germany, Italy, and France, but not in England, though the contrary has been stated. During this century, owing to the vastly extended commercial relations between every civilized country, it has, like the Cattle-plague and Lung-plague, become greatly extended, and prevails more severely and continuously than before. In the Old World, its ravages are now experienced from the Caspian Sea to the Atlantic Ocean. It gradually extended

towards Britain at the commencement of this century, after invading Holland and Belgium, and, about 1839, appeared in this country, where it was soon recognized as a new disease; it quickly spread over the three kingdoms. From the observations of the best authorities, it is an altogether exotic disease in the west of Europe, always arriving from the East: at least, this has been the course noted in all the principal outbreaks. It was introduced into Denmark in 1841, and into the United States of America from Canada, where it had been carried by diseased cattle sent from England. It gradually extended, through cattle traffic, to the districts beyond the State first invaded. It was twice introduced into Australia, in 1872, but was extinguished on each occasion.*

It appears to be well known in India† and Ceylon, Burmah, and the Straits Settlements. In 1870, the disease was introduced into the Andaman Islands, where it had not until then been seen, by cattle imported from Calcutta, where it was then prevailing. It appears to be common in South Africa, and is frequently epizoötic there: causing great inconvenience, owing to the bullocks used for draught purposes, and which travel great distances, becoming unfit for work, by which traffic is much interfered with. These also spread the contagion.

* There was really only one outbreak, in Victoria, among the cattle on two farms, into which it had been introduced by an imported bull. These cattle were destroyed, and with them the disease. Two cargoes of diseased cattle arrived at Sydney from England; but they were quarantined on an island, and every precaution was adopted to prevent the infection extending to the mainland until the malady had entirely disappeared. In this way has the Australian colonies been spared the infliction of a serious evil, and afforded a lesson to other countries.

† "*Foot-and-mouth disease* is a universal disease of cattle in India, causing a considerable amount of sickness yearly, much disabling of cattle, considerable inconvenience, but no great mortality. It appears to be even more common and frequent than any other form of cattle disease. . . . . It appears generally in the hot season, but may prevail at other times. Villagers everywhere in India—Bengal, Madras, Bombay, &c., and Ceylon—are familiar with it, and have eagerly attested its existence, even when the severer disease (Cattle-plague) was denied or concealed."—*Report of Indian Cattle-plague Commission*, p. xiii.

It is not improbable that it also prevails in Central Africa.*

CHARACTER.

Aphthous fever is an eruptive, epizoötic, and contagious disease, affecting the skin and mucous membranes, and appearing most frequently in cattle, sheep, goats, and pigs; though wild animals—as deer and boars—are not exempt; it may also be transmitted to other creatures, and instances are on record in which people, horses, dogs, and poultry have been infected. It is characterized by an eruption of small vesicles, or phlyctenæ, either confluent or isolated, on the lining membrane of the mouth—rarely extending beyond the mouth internally—and the interdigital space (seldom the nostrils) of bisulcate animals. The eruption may appear in both of these situations in the same animal, or only in one; in certain outbreaks, or in certain species, one of the regions is more frequently affected than the other. When the horse is attacked, the eruption is only observed in the mouth (Röll). In bovine animals, the vesicles not unfrequently appear also on the udder and teats. In sucking animals, it sometimes is noted in the larynx, pharynx, stomach, and intestines.

It is of brief duration, as a rule, and generally benignant.

NATURE.

Beyond the fact that this is an eruptive fever, allied in its general characteristics to all other eruptive fevers, we know but little. Hadinger has endeavoured to prove that the symptoms are due to the vegetation of a species of Leptothrix, similar to the "rust" of plants; and Spinola has found the

* Schweinfurth is the authority for this surmise. Speaking of the Dinkas, an eminently pastoral tribe in Central Africa, he mentions that, during the rainy season of 1870, their cattle were decimated by plagues, especially those in the district of Lao, where thousands were lost. "The most common of the cattle-plagues was called Atyeng by the Dinka, showing itself by open wounds, like lance-cuts, in the hoofs; sometimes the wounds would make their appearance on the tongue, rendering the animal incapable of grazing, so that it could get no nourishment, and sank through exhaustion."—*The Heart of Africa* (London, 1873), vol. ii. p. 280.

oïdium albicans among the epithelium of the mucous membranes involved in disease. Bender has also found a fungus—a kind of *Tilletia*—in the efflorescences which mark this disease. The malady is somewhat analogous to the *eczema impetiginodes*, *impetigo simplex*, or *impetigo phlyctenodes* of man.

CAUSES.

We know no more of the causes which originally develop this malady than we do of those of Variola, Cattle-plague, or Lung-plague. Every cause that tends to diminish health has been invoked ; but no sooner is it investigated than it is found to be impotent to produce the disease. Sudden atmospherical changes, feeding upon altered or unhealthy food containing the ova of insects and covered with mould (we have just quoted Hadinger's opinion), drinking putrid or muddy water, grazing in marshy regions, fatigue in travelling, &c., have been cited as occasional causes. We only know that it nearly always appears in an epizoötic, rarely in a sporadic form (and then chiefly in the horse); that in certain years it becomes widely extended, invading whole countries, progressing from the east towards the west in Europe ; and that its extension is due to its contagious properties alone, and the facilities offered for the dissemination of the virus.

Certain inscrutable influences, however, appear to be in operation in exalting the virulence of the contagium and the malignancy of the disease during these great outbreaks ; and it has been observed on the Continent that these are often accompanied or preceded by extensive invasions of Anthrax. In Russia, it has also been frequently coincident with Cattle-plague. Individual conditions would likewise seem to have some influence in predisposing the organism to its invasion or severity. Among these may be enumerated fatigue, bad hygiène, pregnancy and parturition, emigration from one locality to another, lactation, and bad or a sudden change of food.

SYMPTOMS IN CATTLE.

As we have said, the malady is characterized by an eruption of vesicles or blisters in the mouth, and on the internal sur-

face of the lips, sometimes in the nostrils, and on parts of the body where the skin is thin and least covered with hair, as on the udder and between the claws. It passes through definite phases, which may be best described separately, as they form the group of symptoms by which the disease is recognized. These phases or periods may be reckoned as four—fever, eruption, ulceration, desiccation.

First Period.

Before any perceptible alteration has taken place in the ordinary habits or condition of the animal, the thermometer indicates an increase of temperature, which gradually ascends to 102°, and as high as 104° or even 107°, in from one to two days, and does not descend to any extent until the end of the eruptive period. The next indication is dulness, inappetence, and slight shiverings. The muffle becomes warm and dry ; the eye is tearful, and the mouth hot and inflamed-looking in places, and frequently sore when handled, the membrane being covered with viscid mucus, which flows in stringy masses from the lips. There is grinding of the teeth, and a smacking or clicking noise ; the breath has a fœtid odour ; rumination ceases, and the prehension, and often the deglutition, of food is painful, the animal preferring to dabble its mouth in cold water. Not unfrequently, when the feet are beginning to inflame, the animal stands uncomfortably, drawing the limbs together, standing uneasy, or jerking them up suddenly under the body, arching the back, and pawing ; the movements are reluctantly performed, and the coronets hot and sore. There is also slight constipation, and, if it be a milch-cow, the secretion of milk is gradually diminished, and that fluid assumes a yellow tint ; in the majority of cases, it is nearly or altogether suspended. The udder becomes red and tense when it is involved, and the teats swollen and painful to the touch. This stage usually lasts from twenty-four to forty-eight hours, according to the intensity of the fever.

Second Period.

After the time above mentioned, the eruption begins to ap-

pear in those parts which are to be its seat, and the fever commences to abate in many cases. When the mouth is chiefly affected, there are seen on its lining membrane, and particularly on the upper lip, gums, and sides of the tongue and palate, white, or yellowish-white, blisters, the size of a grain of millet to that of a pea or nut, their form being very irregular. Sometimes they are discrete, or scattered over the surface; in other cases, they are confluent, collectively forming patches which are at first gray or yellow, and afterwards white; slightly convex, each vesicle is usually circular; the smallest are seen on the muffle. In the mouth, they are largest, and most frequently confluent; but there they only exist for a brief period, the friction taking place in the movements of the tongue tearing them; the epithelium is detached in flakes of variable dimensions, leaving unhealthy ulcers, or denuded spots, or "erosions" of a bright-red tint, which contrasts markedly with the gray hue of the surrounding surface. These shreds are often seen adhering to the border of these sores; and if on the tongue, that organ is kept continually moving to get rid of them, and the animal emits a smacking sound with its lips. Where there is no friction, the vesicles do not rupture within one or two days. On the udder, the vesicles are somewhat different. The teats are most frequently their seat, and it is not unusual to find the phlyctenæ grouped in a circle around their orifice; when isolated on the surface of the organ, they are surrounded by a pale-red circle, and when confluent they are very irregular and variable in number. We have mentioned the alteration in the milk of the cow, which is more striking in this than any other animal.

When the limbs are affected, the heat and redness of the coronet are most notable towards the heels and the interdigital space of one or more feet. The coronet swells; the animal is lame, and prefers to maintain a recumbent position. In one or two days the vesicles are developed at the points indicated, most frequently earliest in front of the interdigital space; at first they are small, but they increase in size until they are as large as a bean or small nut, and extend around the claws, often becoming confluent, the contents appearing

as a yellow limpid fluid. The skin of the part assumes a blanched aspect, and is soon covered by a kind of cheesy matter, resulting from the inspissation of this fluid, which emits an ammoniacal odour.

In some cases, the skin around the base of the horns becomes inflamed at the same time as that of the mouth or feet, and the horns are loosened. Occasionally, also, a vesicular eruption manifests itself at the orifice of the vagina, at the perineum and anus, or in the nostrils; and it sometimes happens that the eyes are affected, the conjunctival membrane becoming inflamed and suppurating, and phlyctenæ forming on the cornea. There may also be nasal Catarrh and symptoms of gastric derangement.

Third Period.

This is the aphthous stage of the disease, and begins when the vesicles have ruptured, and, the epidermis being removed, erosions appear. This does not occur everywhere at the same time, but varies according to the region: in the mouth it soon occurs, owing to the movement of the tongue, and also in the feet by that of the claws. On the udder it is later, seldom occurring before thirty-six or forty-eight hours; or if the disease is benignant the vesicles on this organ may not rupture at all, their contents becoming absorbed, and the pellicle of epidermis covering them scaling off when cicatrisation has taken place beneath. When the vesicles do break, there remains a little bright red sore which is smooth or granulating, and is soon covered by a fluid pus or yellow exudat of epithelial cells, which, in drying, forms a thin reddish crust that protects the erosion until it heals.

In the mouth and on the lips the vesicles are broken almost as soon as formed, leaving circular or irregular bright-red sores, which bleed readily; their rupture being indicated by dribbling of saliva streaked with blood. It sometimes happens that when the tongue is seized to explore the mouth, large patches of epidermis come away in the hand, as if the tongue had been boiled. In some rare cases, an exudation of

a yellow colour and cheesy consistency is observed towards the root of the tongue, due to epithelial proliferation.

The fever has greatly subsided, but the thirst is intense, and the animal eagerly drinks water or gruel; though owing to the soreness of the mouth it can eat but little, especially if the food be dry and hard. Consequently, the loss of condition is rapid.

Fourth Period.

This is marked by the desiccation or drying-up of the aphthæ, and the formation of new epidermis. The crust falls off, and the new epidermis or epithelium appears as a thin lead-coloured pellicle. With the completion of this process all traces of the disease disappear. There is no lameness, the appetite has returned, and lost condition is being restored; while the secretion of milk, which may have been greatly diminished—perhaps to less than one-third—becomes augmented, and regains its normal properties.

SYMPTOMS IN SHEEP AND GOATS.

In these animals, the symptoms differ but little from those observed in cattle. The fever is not so marked, however; though the temperature may rise as high as in the bovine species, and the patient lies apart from its companions, dull and weak-looking, and can only be made to rise with difficulty. It makes a peculiar smacking sound with its lips, which are kept moving as if it were sucking. The mouth is hot, pasty, and filled with a viscid saliva, and in walking the animal goes unsteadily. The vesicles in the mouth form chiefly on the incisor pad—more rarely the whole mouth and tongue—and the eyes, as well as the vaginal membrane, may be involved.

The eruption is more frequent on the extremities than in the mouth, but the formation of vesicles is not very common; most frequently the skin around the claws and in the interdigital space is swollen, and more or less red, and from its surface a fluid escapes which, in drying, gives rise to crusts. The inflammation in this region not seldom runs on to sup-

puration, involving sometimes the biflex canal, or producing disunion of the hoofs; and if precautions are not taken in these cases, the disease may assume a very serious form. The loss of condition is more or less marked.

SYMPTOMS IN THE PIG.

With the pig the mouth eruption is rare, that of the feet being most common. When the mouth is affected, the snout and the parts adjoining are involved. The manifestations of the disease do not differ from those observed in the other animals; though the feet are liable to take on a high degree of inflammation, especially if the animal is compelled to walk much on hard or muddy roads, or is exposed to other unfavourable conditions. Progression causes intense pain, and there appears to be a great tendency to shedding the hoof. The pig persists more in maintaining a recumbent position than the sheep. If a sow, the udder is implicated like that of the cow.

SYMPTOMS IN THE HORSE.

As has been mentioned, Aphthous fever affects the equine species, and, according to some observers, appears in an epizoötic form; though the fact of its being transmissible from cattle to the horse has been much doubted in this country. The early symptoms are similar to those noted in the cow when the mouth is affected. There is fever, the lining membrane of the mouth is hot, red, and covered with a quantity of viscid stringy mucus; while mastication is difficult, and the horse loves to lave its mouth in water. On the inner surface of both lips, at the mucous glands, appear vesicles the size of a grain of millet, which increase to that of a pea, and are filled with a transparent serum. These vesicles soon rupture, leaving erosions that are quickly covered with new epithelium. Within from seven to ten days, the malady passes through all its phases, if there is only one eruption of vesicles; but it may be prolonged to two or three weeks if there are a succession of them, and the animal becomes emaciated in consequence of being unable to eat. In other cases, in

consequence of the intense inflammation of the mucous membrane, the inner surface of the lips and cheeks, the gums and the upper surface and sides of the tongue and adjacent parts, are covered, according to Röll, with patches of somewhat thick gray-coloured exudation of variable size, and which often coalesce; these are surrounded by an intensely red areola, and adhere intimately to the subjacent membrane, which is eroded, and bleeds readily. Sometimes the tongue and parts of the lips are covered by a continuous layer of this exudat, which is of a croupal or diphtheritic nature, and blends itself with the mucous membrane. In these instances the fever runs very high, and the secretion of mucus great. Often also, Röll mentions, there exists at the same time a croupal or follicular inflammation of the pituitary membrane, follicular ulceration in the vicinity of the mouth and nostrils, inflammation of the lymphatic vessels of the cheeks, and swelling of the glands, catarrh of the bronchiæ, Pharyngitis, and acute catarrhal inflammation of the gastric and intestinal mucous membrane. In certain cases, a vesicular eruption has been observed on the posterior part of the hind pasterns when the skin is white.

SYMPTOMS IN FOWLS.

In birds, the eruption appears in different regions: in fowls, the vesicles appear more particularly around the nasal openings and on the crest, though they are also seen in the mouth and nostrils; in geese the feet and interdigital membrane are chiefly affected.

COURSE AND TERMINATIONS.

As a rule, this aphthous or vesicular fever runs its course without much constitutional disturbance in from eight or ten to fifteen days, and its termination is generally favourable under good conditions of hygiène and careful nursing; though convalescence is generally slow. But when the animals are placed in unfavourable circumstances, as when kept in filthy stables or wet pastures, travelled on hard, rugged, or muddy roads, submitted to improper treatment, &c., or a virulent

type prevails, the disease may assume a troublesome, if not a serious and most painful character, by the inflammation in the feet extending to the vascular tissues covered by the hoofs, and the formation of abscesses, which can be distinguished by the white colour of the horn covering them. These abscesses may open at the coronet; but in other cases, through inattention or maltreatment, the matter may form sinuses, detach the hoofs, destroy the ligaments and joints, and ultimately lead to the destruction of the animal. It may be remarked that the loss of the hoof of one claw from two or more of the feet, is not so serious as the simultaneous loss of both from one foot. And as Professor Brown has pointed out, even when the vesicles are neither numerous nor large, there is often present an irritable condition of the mucous membrane of the mouth, accompanied by exudation beneath the epithelium, causing it to become loosened and fall off, leaving the sensitive parts exposed. He gives an instance in which the entire cuticular covering of the anterior portion of the tongue came away in the hand of an attendant who was endeavouring to seize it, leaving the bleeding member exposed, and the poor animal trembling with pain. Sometimes the organ is greatly swollen and protrudes beyond the mouth, and the sublingual glands are extremely tumefied.

The udder may also be the seat of abscesses or induration, as a result of the disease. It may also assume a serious character when the eruption extends to the respiratory or intestinal mucous membrane, being then accompanied by a low but severe fever, fetid Diarrhœa and Coryza. This form has been observed in Russia, and sometimes it has been mistaken for Cattle-plague. The disease is also very serious in sucking-calves, particularly when the udder of the cow is affected, the intestinal canal being generally the seat of the eruption; thus giving rise to serious Diarrhœa, swelling of the head, great prostration, and death in two or three days.* This "internal" Aphthous or Catarrhal fever appears to be occurring more frequently than in former years.

* See a paper by me on this form of the disease in the *Veterinarian* for 1869, p. 883.

Professor Brown observed cases in London in 1870, in which there were "effusions into the areolar tissue beneath the skin of the legs and some parts of the body, and when the enlarged parts have been punctured the discharged fluids have always been extremely fetid; great prostration accompanies this form of the malady, and death frequently results."

Not unfrequently the appearances in the intestinal canal are not unlike those of Cattle-plague; and this form has been named the Typhoid complication of Aphthous fever by the continental veterinarians.

Sometimes there is observed in fine-skinned animals, and particularly in the pig, a vesicular or papular eruption on different parts of the skin, as well as tumours, which become abscesses, or œdema of an erysipelatous character affecting the limbs.

In horses, this vesicular fever is also at times troublesome, and even serious, when it presents itself with the severe symptoms we have described; and recovery takes a much more considerable time than in ordinary cases, owing to the slowness with which the ulcers heal, and the fact that the exudation does not take place simultaneously, but successively, occupying two, three, or four weeks. During this time the loss of condition is great, and until the animal can eat well it does not regain it.

PATHOLOGICAL ANATOMY.

The pathological anatomy of the disease in mild cases is very simple, consisting only in the elevation of the epithelium or epidermis by the limpid fluid that forms the vesicle, and which, by its accumulation and the softening of its envelope, causes the rupture of the latter. The aphtha remaining is very superficial under ordinary circumstances, and in the mouth especially; on the feet, however, the erosion is usually deeper, and in the interdigital region of the sheep frequently becomes a deep ulcer that may cause the disease to be mistaken for Foot-rot. In cattle also, owing to the movements taking place in this region, the aphthæ and their accompanying inflammation may destroy the skin, involve the textures beneath the

hoofs, lead to loss of these, disease of the ligaments, and ultimately of the bones.

Aphthæ and vesicles may also be found on the palate, in the pharynx, and on the mucous membrane of the true stomach and duodenum. In the two last, they more frequently appear as sharply defined ulcers in the middle of discoloured patches. The mucous membrane of the intestines may also be reddened, and marked by hæmorrhagic spots; Peyer's patches and Brunner's glands partaking of an ulcerous character.

Serous and sanguineous infiltrations have been found among the muscles; but these have been attributed to the fatigue the animals experienced in travelling to the markets. When examined microscopically, no alterations of an unusual character, nor morbid productions have been observed in the muscles; with the exception of the *psorospermia* which are usually found in abundance in the bodies of animals that perish from other diseases.

We have already remarked that Hadinger discovered a microscopical vegetable parasite analogous to the *oïdium albicans*, in the diseased mucous membrane of the mouth of cattle affected with this malady. Flemming has also recently found this cryptogam in Aphthous fever.

The blood has also been examined microscopically, but nothing unusual has been noted except excessive molecular activity, the red globules being nearly all star-shaped, changing their outline frequently, and at last assuming the ordinary circular form. Leucothytes or white globules are more numerous than usual, Bacteria and Vibriones are always noticed, and many minute spherical bodies moving freely in all directions.

The saliva, when carefully gathered and examined, is perfectly pellucid, contains small stellate crystals, and minute spherical bodies or monads, the latter possessing great activity of movement. In the fluid of the vesicles are large nucleated cells and masses of living germinal matter, besides Monads, Bacteria, and Vibriones. The fluid discharged from the eyes appears to contain similar bodies.

The milk has been found of low specific gravity (1024),

though it generally yields a moderate proportion of cream. Large granular cells, or white corpuscles, having the general character of pus globules, were constant, and present throughout the whole course of the disease, and even for some time after recovery; though they were most numerous during the height of the malady. Monads and Bacteria were also observed, and boiling did not affect their form or movements. The specific gravity of the milk was found to rise slightly during convalescence from 1024 to 1027, the last being nearly the normal standard. In two instances, the specific gravity was respectively 1032 and 1034, the quantity in each case being reduced to one-fifth of the usual yield. Milk obtained from affected animals in the evening commenced to decompose by the following morning, though when boiled it remained good for twenty-four hours (Brown).

DIAGNOSIS.

The diagnosis of this malady is very easy, and it is almost impossible to mistake it for any other disease. The manner in which it appears in a stable or herd, its well marked contagious character, its symptoms and course, and the comparatively mild form it generally assumes, distinguish it from all diseases having any analogy to it. When the eruption appears on the udder, the size of the vesicles might lead the inexperienced to mistake it for the pustule of Vaccinia, but a careful study of the two eruptions will quickly dispel that error.

CONTAGIUM.

The contagium is both "fixed" and "volatile," according to the opinions of the best German authorities, who also imagine the disease to be miasmatico-contagious. Several of the French authorities deny the volatility of the contagium, and contend that it is fixed. Careful observations are required on this point; though it is not improbable that the emanations from animals severely affected may contaminate others a short distance off, particularly in close buildings, or when a strong wind is blowing. Assuming, however, for the sake of safety, that it is both fixed and volatile, but that its volatility is feeble; it

only remains to add that it exists in its most concentrated form in the lymph or serum of the vesicles, and in the saliva ; but this is not its exclusive vehicle, as other products of secretion—the milk for instance—as well as the blood of diseased animals, contain it. It is most probably present in the volatile, as well as the fixed condition, in the excretions.

When it first makes its appearance in the disease is not, to my knowledge, perfectly ascertained ; but it is certainly present at the formation of the vesicles, and remains until the febrile stage has passed over, and until these have dried and cicatrized. Brown mentions that sucking calves have been frequently poisoned by it, even before the cow gave evidence of the disease, which then existed in the incubative stage.

It exerts its influence on the bovine, ovine, porcine, and other species. Deer, horses, dogs, rabbits and hares, poultry, and even mankind are more or less susceptible to its action, though not all to the same degree. The intensity of the contagium, as well as local circumstances, influence it in this respect.

VITALITY OF THE VIRUS.

The contagium of this disease appears to be endowed with a considerable degree of vitality, as it has infected healthy animals a long time after it had left the sick creature which elaborated it. Four weeks after the disappearance of the disease, the dung of infected animals has caused an outbreak in a team of oxen employed in carrying it away from the farm and ploughing it into the ground, and these oxen contaminated other creatures. The disease prevailed nowhere else (Rosenkranz). In another instance, three months after the extinction of the malady in a district, two calves which had been affected with it were brought to a manor-house, and ten days afterwards the disease appeared (Haubner).

Zundel has known instances in which stables have retained the virus for a very long time, either in their walls or in the air confined in them. The disease has been communicated to animals in such stables after they have remained vacant for fifteen days.

The same excellent authority also states that he has known the virus to be preserved for a long period in forage, although this had not been impregnated by saliva from the disease, but only exposed to the atmosphere of the stable they had inhabited.

One of the outbreaks in Australia in 1872, is said to have been due to the importation of a cow or bull from Britain, which had exhibited no symptoms of the disease during the voyage; the virus is believed to have been present in the last truss of hay given to the animal, which sickened therefrom as it entered Sydney harbour.

Many other cases are on record to prove the tenacity of the virus; but the following, which I have been fully assured are accurate by a competent observer of the facts, are perhaps the most striking, and afford an example of the subtle manner in which the contagium may obtain access to healthy animals, even when every care has been taken to guard them from it. These are the cases in which the disease is supposed to appear *spontaneously*, or to be due to "something in the air."

About two years ago, a farmer in the neighbourhood of Shorne, a village lying some distance from the high-road between Gravesend and Rochester, and isolated from all cattle traffic, bought a number of young cattle (24) at Kingston fair. As he had suffered a good deal from the effects of Aphthous fever some months previously, he was determined to adopt every precaution to escape it for the future; consequently, he had these cattle quarantined in a yard, where they remained for more than a month without showing any symptoms of the disease. At the end of that time he was desirous of feeding them out of troughs, and a number of these were brought from a field a long way off, where they had been employed to hold the mashes and other soft food given to the cattle which had been sick some four months previously. These troughs had been allowed to lie in the field from that time up till now, exposed to the snow and rain of the winter, and three days after the new stock had been feeding out of them, the first case of disease appeared, and soon the whole of the animals were affected. The troughs were not at first suspected, and

the greatest mystery prevailed, as well as alarm; for such an outbreak seemed to put even quarantine measures at defiance. There was no disease in the neighbourhood, no droves of strange cattle had passed within miles of the farm, and no infected animals had ever been in this particular yard; and the mystery would have perhaps remained unsolved, had the experienced veterinary surgeon (Mr. Martin, of Rochester), who was called in to attend the diseased stock, not been furnished with the history of the outbreak.

The other case occurred in the same locality at another time. A farmer owned two farms in an out-of-the-way place, and some distance from each other. On one of the farms the disease had prevailed rather severely, and the animals had been fed out of the ordinary field hay-racks. The disease disappeared, and nothing more was seen of it until five months afterwards, when one of these racks was brought down to the other farm where the malady had not been, and very soon the cattle which fed out of it sickened. There was no traffic in the locality, nor yet disease, until the tainted rack was carried down.

These instances, in addition to the other lessons they teach, show the necessity there is for disinfection.

INFECTION.

No circumstances connected with breed, sex, or age, appear to afford any perceptible immunity; and the transmission of the malady may be effected through direct or indirect conveyance of the virus from the sick to the healthy, in its fixed or volatile forms. We know not whether wild creatures primarily develop the disease, or whether its appearance in them is consecutive to frequenting pastures where diseased domesticated animals had previously been. The order of susceptibility to receive the infection may be thus stated: cattle, sheep, goats, camels, pigs, deer, rabbits, hares, mankind, fowls, dogs, horses.

Authorities in this country have denied that the disease can be transmitted to horses or even to mankind; but there is strong evidence to prove that this transmission has taken

place in England, and there is still stronger proof that it has done so on the continent. Cases have been observed at the Turin Veterinary School, and others are described by Hurtrel d'Arboval, Levrat, Levigney, Villeroy, Dubos, Lafosse, Lemaire, Serres, Stockfleth, &c., all due to contact with the bovine species. Doubtless, the transmission is rare, but there appears to be no reason to deny its possibility. In 1873, Janné, a trustworthy veterinary authority at Maestricht, Holland, reported three horses affected with the malady from eating forage soiled with saliva from diseased cattle; the veterinary surgeon attending these horses became inoculated through handling them.

Hering and Adam have seen dogs affected after partaking of milk from diseased cows. Girgas saw it affecting camels and dromedaries; and, in 1845, Miltenberger reports that between three and four hundred deer perished from its effects at Schelestadt. Rychner also mentions that in 1838, during the extensive epizoöty, the chamois in Switzerland suffered very much, the disease in them being accompanied with great swelling of the head of an erysipelatous character.

Spinola and others have witnessed it in fowls, and especially in palmipeds.

With regard to its transmission to mankind, there can be no doubt whatever; though it is more frequent in some outbreaks than others. The evidence of Falke, Fuchs, Adam, Sagar, Hertwig, Jacob, Hildebrand, Bouley, Zundel, and a host of other veterinary surgeons, as well as medical men, is overwhelming in this respect.

MODES OF INFECTION.

Infection, as we have just said, may take place directly or indirectly, and by a fixed or volatile virus. As we are ignorant of the distance to which the atmosphere may carry this virus, we cannot do more than allude to the fact of its being volatile. It may be mentioned, however, that Zundel believes that contagion is possible at 100 mètres distance.

The modes in which the infection may be propagated are numerous, and sometimes complex. Roads are fruitful

sources. When animals—cattle, sheep, and pigs—are driven to fairs or markets, often at considerable distances, it frequently happens that they travel along roads which have already been traversed, or are daily frequented, if the disease prevails in the locality, by those affected with the malady; in which case they are almost certain to become infected. In Austria and Prussia, where large fairs are held, and droves of cattle, sheep, and pigs are driven great distances by road, if healthy at starting they nearly always become contaminated if they have to pass through infected districts; and in this way they are themselves afterwards instrumental in spreading the contagion far and wide. The droves of swine from the East—Poland and Hungary—and which travel by roads or railway to the German markets, are always looked upon as active agents in this respect.

Depasturing animals on commons is another fertile mode; as new and infected cattle are frequently introduced, or the others have to pass across or along roads where they may receive the contagion. The disease is also diffused by means of the stables or lairs in the vicinity of fairs and markets. Animals which have been sent to these are frequently lodged for one or more nights in such places, where they may meet diseased cattle, or where the infection from these may yet remain. The fairs and markets themselves are, for the same reasons, grand sources of infection.

The introduction of newly-purchased stock into a stable or farm without careful inspection before purchase, or without taking any precautions previous to mixing them with the old stock, is also another very frequent mode of propagation.

It is not at all unfrequent to find the cattle inhabiting a very large stable become affected with the disease a few days after a sick animal has been placed therein. Animals which have been in contact with the diseased, even for a short period, have subsequently infected others, though they themselves have remained healthy; and others apparently quite recovered, have disseminated the contagion.

Drinking at the same watering places or troughs, and feed-

ing off the same ground or out of the same racks with the diseased, is nearly certain to transmit the contagion.

Railways and cattle-ships play a very important part in disseminating the disease over great distances and maintaining it for long periods of time. In this country, it cannot be doubted that the ships employed to carry cattle from Ireland to England and Scotland have wrought an incalculable amount of mischief in infecting animals with this disease, as well as with contagious Pleuro-pneumonia. Each ship has been a focus of infection, from which animals embarked in good health have received the poison, carried it with them into fairs, and thence into every county and district. The danger of buying Irish cattle, from their being so often affected with contagious diseases, is notorious; and yet in their own country they are less visited by these diseases than English cattle would be were these not tainted by importations. It has been the same with railway waggons as with cattle-ships.

Forage impregnated with the saliva from diseased mouths, litter on which cattle whose feet were affected have stood, and people or animals, &c., which have been about the sick, will all act as bearers of the contagium. Innumerable instances are on record to substantiate this statement.

MODE OF ACCESS.

The contagium may find access to the blood by the mouth, air-passages, or any other part where the mucous membrane is thin and vascular, as the generative organs. It may also be absorbed by the skin, as between the claws. It is readily inoculable.

Fowls contract the disease if they frequent places where the ground or litter is soiled with virulent saliva.

INCUBATION.

The latent period of this disease is brief, usually from three to six days after contamination; though it has been known to be only 24 hours, and as long as 10 and 12 days. A case is given in which a diseased cow brought by railway to a farm, caused an outbreak in 24 hours afterwards. In another place to which the same animal was immediately afterwards

sent, the incubation was five and six days, and in a stable where it subsequently remained only one night, the period in one case was ten days.

Benedict speaks of a bull that was put to a diseased cow, and afterwards, on the same day, to three other healthy cows from different farms. In three days the bull was affected, and in six days the three cows.

Experimental transmission has shown that the latent period may extend from 50 to 90, or even 100 hours; though the latter period is rare. The thermometric test may reveal the commencement of reactionary fever 10 or 12 hours before any other symptom is recognized.

EXTENSION.

We have already stated all that need be said on this subject, when speaking of the mode of infection. The disease may be briefly said to become diffused by fairs and markets, railroads and steamboats, highroads and pastures, ignorance and carelessness; and through the medium of drovers, butchers, veterinary surgeons, policemen, and others who go among cattle. It extends most rapidly in the summer season, when there is most opportunity for infection, and in a country where agriculture is flourishing and cattle numerous.

MORTALITY AND LOSS.

The mortality from the disease is comparatively trifling, and then only occurs when serious complications arise. This at least is the case with adults; with very young animals it is more serious, and the per-centage of deaths among them is sometimes considerable.

It has been calculated that, in recent invasions of the disease in this country, the average loss by death in those localities where it was very severe, was ten per cent., and Professor Brown states that, in one dairy in the metropolis, 16 died out of 86.

In what has been designated the "catarrhal" or "typhoid" form of the disease, as well as when it is attended with other serious complications, the mortality is great. According to

Rychner, during the prevalence of the malady in 1839, the first mentioned form was very marked in Switzerland, and more than 2000 cattle perished in the Alpine pastures of Berne and Fribourg. In 1872, Zundel has seen 20 to 30 animals die of this complication in a single commune in Alsace. In the Niévre, in 1872, there was a mortality of about five per cent.; of 17,968 sick cattle there succumbed 894, the majority of which were young animals. In 1869, Stockfleth reported a mortality of three to four per cent. among the adult cattle at Copenhagen.

In the Government of Orenburg (Russia), Jessen states that in nine years the disease had killed 1354 of 5341 affected cattle.

Its most serious feature, however, consists in its affecting a large per-centage (frequently nine-tenths) of the animals on a farm or in a district. As an instance of its peculiarity in this respect, Hering states that in 1839, in a district in Wurtemburg, comprising about eight square miles, and containing 11,000 head of cattle, only 1300, or 12 per cent., escaped. Zundel has remarked that in the years 1862-3-4, while the disease prevailed in the arrondissement of Mulhouse, Alsace, containing 32,000 animals, only about 4000 escaped, or one in eight. In 1869, the disease was still more severe.

In 1839, of 277,000 cattle in the department of the Nord, France, it has been estimated that 120,000 were attacked by the disease. It affected, according to Lemaire, more than one-half of the sheep, and one-fifth of the pigs.

In the Duchy of Baden, in 1864, according to Fuchs, of 607,825 cattle, 139,995 were affected, or one in four and a-half.

When it is considered how rapidly animals lose condition, especially fat stock; what losses occur when it appears amongst milch cows, or amongst oxen used for draught, and among sheep, pigs, and poultry; and the embarrassment it may from its presence occasion to agriculture, and the cattle and milk trade; as well as the expense of curative measures; it cannot be doubted for a moment that this is a great scourge, even under the most favourable circumstances. It is still more so when the disease assumes a severe type, and is liable to be attended

with complications, such as disease of the bones and ligaments of the feet, and loss of the hoofs, inflammation and perhaps permanent induration of the udder, disease of the tongue, &c. There is also the deleterious effect of the milk upon young animals to be taken into account, as well as the losses from abortion.

It is scarcely possible to arrive at anything like a correct estimate of the number of cattle affected during any particular invasion in this country. Perhaps it would not be an exaggeration to assert that 150,000 or 200,000 suffered from the disease in 1872; and setting the loss per head at the very low estimate of £3, we gain something like an idea of the nature of this scourge in an economical point of view. This is, of course, excluding the other species which may suffer from the transmission of the disease; and also keeping out of view the loss entailed by embarrassment to traffic, inspection and other heavy expenses.

The money loss (direct) from the malady in this country has been estimated at £13,000,000, but there is reason to believe that this is below the truth. In Leicestershire, for instance, where an attempt was made to obtain returns of the numbers and species of animals affected, and where the loss on each bovine animal was put down as under £2 (considerably below the estimate given by many of the owners), sheep at 10s., and pigs, 10s., it was computed that a sum total of upwards of £340,000 would not have covered the loss the farmers and graziers experienced in that year from this disease alone.

Zundel, on the Franco-German frontier, estimates the loss sustained by the illness of each animal at an average of 30 francs; under the most favourable conditions it must always exceed 20 francs. Fuchs has calculated that the loss experienced by the Duchy of Baden in 1869, was no less than 1,244,124 florins, and for the Southern States of Germany 10,000,000 of florins. Viseur is of opinion that France must have lost in twenty years from this disease, among cattle only, 100,000,000 of francs.

The great rapidity with which it spreads greatly heightens these losses. In a very few months it has been observed to

enter the western frontiers, and spread over a large portion of the continent: infecting Bavaria, Wurtemburg, Switzerland, Alsace, and other parts of France, and reaching Belgium, Holland, and England—always following the course of traffic.

IMMUNITY.

What makes this malady still more serious, is the fact that one attack does not afford protection from another, nor yet several subsequent visitations: animals remaining susceptible to it after being affected several times. A cow has been known to have two attacks within a few months. Three, four, and five attacks in the same animal are recorded. Nevertheless, some authorities have observed that those animals which have had the disease are, for a certain time at least, less susceptible than those which have not had it. This diminished susceptibility, however, does not withstand a very severe test, nor yet does it continue for long.

SANITARY MEASURES.

The sanitary measures necessary to prevent the invasion or extension of this disease, must be similar to those already prescribed for other contagious maladies; though the miasmatic influence which, by some authorities, is said to operate in its development and diffusion, does, in their opinion, militate against the adoption of severe measures. But though we are not in a position to go so far as to deny the presence of some such influence; yet our experience of the malady, and the teachings of its history, plainly show that the disease owes its extension mainly to its contagious properties, and that in those countries which it visits, it follows the movements of cattle, sheep, and pigs, its foci being principally fairs and markets or other agglomerations of these animals; that in countries where there is no importation from those where the malady prevails, or where care is exercised in admitting strange cattle, the malady is unknown; and that by proper precautions a farm, a district, a county, or a country may be kept free from it. It has never

appeared in a country where its introduction could not be traced to the importation of foreign stock (Australia and America, for instance).

So that, so far as all the evidence hitherto collected tends, we must look upon this vesicular fever as a contagious disease in every sense of the word, and base our sanitary measures on the knowledge we possess of its characteristics in this respect.

PERMANENT SANITARY PRECAUTIONS AGAINST INVASION.

When the disease prevails in an adjoining country, ruminants and pigs, if allowed to be imported, should be carefully inspected before exportation, a certificate of health accompanying them; and they should only be admitted by special ports, or allowed to travel by certain roads, after another inspection at the point of entrance. Indeed, the general preventive prescriptions with regard to the introduction of contagious diseases in general, should be followed with respect to this disease.

The careful inspection of all admissions should be attended to; and if there is any doubt or suspicion, as the incubatory period of the disease is short, quarantine may be easily carried out.

The importation of forage from districts in which the disease is prevalent, should also receive attention.

Should the disease be discovered among ruminants or pigs at a port on their arrival, they may either be sent back, or detained under the strictest isolation until they have recovered, and a suitable period has elapsed; or, if fat stock, they may be slaughtered at the landing-place.

SUPPRESSIVE MEASURES.

When the disease appears in a country, isolation and disinfection must be looked upon as the principal measures to be enforced.

If it shows itself in a locality, warning should be given to neighbouring localities, so that they may adopt suitable pre-

cautions to prevent the extension of the disease to their own stables.*

The infected stables, as well as those immediately adjacent, should be carefully isolated until three weeks after the disease has disappeared. The healthy and suspected animals should be separated from the diseased, and form two groups, also kept apart from each other; these must not be allowed to go near the sick, to travel along the same roads, nor to drink at the same watering-places. Neither should any persons but those specially engaged for the purpose, be permitted to go near the sick cattle, nor to frequent the infected stables.

The sale of affected animals, or those which have been in contact with them, should not be allowed, except for immediate slaughter, and then only on the spot, until three weeks after the recovery of the last case of disease. No animals should be sold from this locality without a veterinary surgeon's certificate of health, guaranteed by an inspection immediately before their departure.

The owners of infected cattle should be compelled to report the existence of the disease to the proper authorities, immediately on its appearance; and no ruminant or pig should be moved out of the stable, or off the farm, until these have made an inspection and adopted measures.

If the malady prevails extensively in a locality or district, it may be judicious to suspend all fairs and markets therein until it has been subdued; and every care should be exercised in the supervision of the movements of cattle. More particularly is this necessary in railway and steamboat traffic.

Disinfection must be carried out according to the general prescription, particularly in railway waggons and steamboats.

With a disease like this, the severe measures applicable to

* The advantage to be derived from this measure is well illustrated by what occurred in Switzerland in 1869. The Foot-and-mouth disease prevailed as severely in the cantons of Thurgovia, Zurich, Argovia, and Bâle as it did in Baden and Alsace ; but the cantons of Berne, Fribourg, and Vaud were free from it, because they prohibited the admission of all suspected animals, and suppressed the frontier fairs and markets. From July until January, 1870, not a case occurred in these cantons, though the malady prevailed on every side.

the Cattle-plague would be onerous, and to a certain extent unnecessary, in consequence of its benignity and short duration; and though it occasions heavy losses and great inconvenience, yet this has been largely due to an utter absence of all reasonable sanitary precautions, and to the neglect of proper hygiènic and curative measures. The authorities are responsible for this; as it was their duty, in addition to devising and carrying out sanitary measures, to inform the public as to the nature of the disease, the steps to be taken to prevent its extension, the necessity for calling in a veterinary surgeon when its existence was suspected, the benefits to be derived from cleanliness and well-ventilated stables, and any other information on points which might awaken the intelligence of cattle-owners, and secure their co-operation.*

* The committee on the Contagious Diseases Act report, with regard to the malady: "Many witnesses have been examined with regard to this disease, especially as to its recent prevalence, both in Great Britain and Ireland, and their opinions have been conflicting, both as regards the amount of loss it causes, and the measures which should be adopted for its diminution. Some agriculturists have recommended very stringent measures, such as the stoppage of all fairs and markets, and of the movement of animals, except by licence, as during the prevalence of Cattle-plague.

"On the other hand, there has been evidence of much weight, both by agriculturists and by professional witnesses, tending to show that such enactments would meet with strong opposition, and would be difficult, if not impossible, to carry out.

"Your committee have come to the conclusion that it is hopeless to attempt to extirpate, or even materially to check, this disease, unless the above-mentioned stringent measures are strictly enforced; and they also believe that such enforcement would require a costly and numerous staff of inspectors, an amount of supervision by the central authority which would excite much local opposition, at any rate in Great Britain, and such an interference with the home trade in animals as would affect prices, and would induce, not only the consumer, but the producer to consider the remedy to be worse than the disease.

"Your committee are confirmed in this opinion by finding themselves obliged to believe that the efforts which have been made in many counties in Great Britain to check the disease under permissive orders from the Privy Council, have been of little or no effect, and that a like failure has been experienced in Ireland, where it has been attempted to carry out a general order by the help of the constabulary.

INOCULATION.

When the disease appears in a considerable herd of cattle, and there is reason to suppose that all will be sooner or later affected, or the separation of the healthy from the sick cannot be properly carried out; it has been recommended, in order to get rid of the disease as speedily as possible, to inoculate all not yet contaminated. The disease is not modified in its character by this measure, its artificial transmission merely abridging the time it would require to pass through the entire herd, and diminishing the inconveniences attending isolation or sequestration. Sometimes natural infection is resorted to with the

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"Your committee, however, consider that the sale in a public place, or carriage of animals affected with this disease, ought not to be permitted. They therefore recommend:—

"(*a*) That the Privy Council should cease to issue orders for the check of this disease.

"(*b*) That section 57 of the English Act, which makes exposure or carriage of animals affected with a contagious disease an offence, should continue to apply to Foot-and-mouth disease, but owners shall be relieved from the necessity of giving notice to the police of the existence of this disease among the stock.

"(*c.*) But that power should be given to the Privy Council to allow the movement, under proper precautions, of animals so affected, for slaughter, food, or shelter; inconvenience having been found to result from the absence of such power."

Consequent on this recommendation, an Order of Council to take effect from and after August 31st, 1873, was issued to the effect that—"Foot-and-mouth disease shall not be deemed to be a contagious or infectious disease with either of the following articles of the Animals Order of 1871, namely, articles 19 and 27. Any regulations made by a local authority under the said article 27, as far as they relate to Foot-and-mouth disease, are hereby revoked.

"Where an animal becomes affected with Foot-and-mouth disease, while exposed or placed, or being carried, led, or driven, as in section 57 of the Act of 1869 mentioned, it may, notwithstanding anything in that section, be, with a licence of an inspector of the local authority authorized to issue the same, but not otherwise, moved for purposes of feeding, or watering, or other ordinary purposes connected with the breeding or rearing of animals, to any land or building in the occupation of the owner of the animal, or for slaughter to the nearest slaughter-house or some other slaughter-house approved by the local authority."

same object, a diseased animal being driven among the healthy ones in order to communicate the malady to them.

Inoculation is easily performed. It is sufficient to take some of the saliva from the mouth of a sick animal, or, better still, the contents of a vesicle in that cavity, and inoculate any part of the body where the skin is thin. Sheep, which are most frequently inoculated in this way, are operated upon in the ear. In forty-eight hours a vesicle appears at the inoculated spot, and the other symptoms manifest themselves. It is even sufficient to rub some of the virulent saliva inside the lips or cheeks of a healthy animal to produce the disease.

Inoculation for this malady has similar drawbacks to those we have commented upon with regard to ovine Variola.

CURATIVE MEASURES.

As a rule, few diseases are more amenable to treatment, and still fewer exemplify the beneficial effects of hygiènic measures, than this.

The animals should be kept in well-ventilated, clean stables, and only allowed to pasture for a short time while the mouth is so sore that they cannot graze. They should be fed on soft, easily-digested food, as boiled turnips, grains, gruel of flour, oatmeal or oil-cake, mashes of different kinds, grass, &c. For drink, they may have bran-gruel, or merely cold water slightly acidulated. Pigs may have gruel also, or milk mixed with bran. During convalescence, when the animals have a voracious appetite, care must be taken not to over-feed them.

If the fever runs high, or there is constipation, treacle, Epsom salts, or common salt may be gently administered in a drench of bran, oatmeal-gruel, or linseed-tea, along with a little nitrate or carbonate of potass. For the pig, an emetic has been prescribed, but all depressing remedies should be avoided.

When the eruption in the mouth is slight, nothing more is required than allowing the animal to lave it in cold water, or water slightly acidulated with vinegar, alum, or sulphuric acid.

When the erosions are extensive and painful, the mouth may be gargled with vinegar and water, hydrochloric acid, honey and water, or a weak solution of tannic or gallic acid in water (one ounce to the gallon). If the ulcers are deep, they will be benefited by dressing with lime water.

In the diphtheritic form of the disease, mentioned as appearing in the horse, besides frequent injections of cold water into the mouth, the ulcers should be dressed with a strong solution of nitrate of silver (eight to twenty grains to the ounce of distilled water).

The udder or teats, when affected, seldom require any attention, except cleanliness and frequent and gentle milking (the mikers guarding themselves from infection by washing their hands and arms afterwards); before and after which operation they may be bathed with tepid water. The teat-syphon may be advantageously used in most cases. Should the inflammation from any cause run high, and there is reason to fear the formation of an abscess in the organ, a suspensory bandage must be used, and appropriate treatment adopted.

When the feet are affected, an expectant method of treatment is to be adopted, if possible. The animals must be lodged in well-kept stables, with plenty of clean, soft litter (sawdust is good); and they should not be allowed to go out in muddy or marshy pastures, or to travel on hard, stony roads. If the hoofs are too long or deformed, they should be trimmed. Exposure to the sun's hot rays is likely to increase the inflammation. It is frequently very beneficial to send the animals several times a day into a shallow running stream, in order to bathe their feet; or some mild lotion may be applied. When the inflammation is acute, it may be necessary to foment or poultice; and when the erosions or ulcers appear, they may be dressed with sulphate of copper, acetate of lead or alum lotion, lime-water, or any mild astringent, or be occasionally dusted with oxide of zinc, or any of the foregoing in powder. Should pus form beneath the hoof, it must be evacuated; and any abscesses which appear, must be opened and treated according to general principles. When sloughing ensues, dressings of carbolic acid and glycerine, or chloride of zinc and

water, will be required, and all disunited horn must be removed.

When the eyes, or any accessible mucous membrane in other regions, is affected, little care is needed, except cleanliness, and the application, perhaps, of a weak astringent lotion.

When there is great debility, nourishing food, and tonics and stimulants must be administered. The best tonic is the various preparations of iron, especially the sulphate, and ale or brandy is a cheap and good stimulant.

Complications must be treated according to their nature.

THE FLESH OF DISEASED ANIMALS AS FOOD.

Up to the present time, there are no facts to prove that the flesh of animals affected with this disease is injurious as food. It has been consumed experimentally and otherwise, and great numbers of cattle suffering from the effects of the malady have been, and are, constantly killed and sold as food; and yet no instance has been discovered of its producing any inconvenience. So that there appears to be no reason to interdict its use as an article of diet, so far as the production of disease is concerned.

There are no alterations which could be certainly relied upon to afford evidence of flesh being derived from animals affected with this disease.

THE MILK OF DISEASED ANIMALS AS FOOD.

If it is unanimously agreed by the principal veterinary authorities that the flesh of diseased animals is innocuous, it is not so with regard to the milk. We have seen that this fluid, besides being diminished in quantity, is also altered in quality during the acute period of the disease. When the udder alone is affected with the eruption, the milk is more creamy, its globules are more numerous and of greater size; and in some cases it contains vibrionæ and bacteria, mucus corpuscles, pus globules, and flocculent masses larger than the ordinary globules, and slightly opaque; it soon *turns*. It is alkaline or acid in its reaction, and ammonia converts it into a whitish glairy mass. When the teats are inflamed, the

milk is yellow, curdy, and often streaked with blood. If the teats are ulcerated and suppurating, the milk is purulent, and has a fetid odour, resembling decomposing cheese.

The experiments undertaken to prove its suitability for consumption as food, have in some instances proved negative, in others affirmative ; just as its general use has done.

In France, in 1839, a scientific commission was appointed to investigate this subject, and it concluded that the milk of diseased cattle was harmless; as, although it had been largely consumed at that time, no accident had been reported. In 1810, 1811, 1834, and 1835, while the disease prevailed in Paris, no precautions were taken with regard to the milk, and yet no epidemy prevailed. Neither could this commission discover that this secretion was pernicious to young animals ; and it concluded its report by stating that it saw no reason to interdict the sale of the milk, as its use had never caused any well-proved inconvenience anywhere. Reynal and other eminent veterinarians endorse this statement.

Besides the cases of infection experimentally produced in our own species, there have in recent years been several instances of accidental infection from the use of this milk in France, Belgium, and in Germany ; and we know that the young of diseased animals are sometimes attacked with a most severe, and even fatal, form of the malady, from (it is supposed) imbibing the milk of their parent.

Numbers of calves sucking diseased cows have died suddenly in this country ; and Professor Simonds produced the malady in pigs by giving them the milk immediately after it was drawn from a sick cow. Professor Brown gave it also to a young cat, and the animal in a short time became weak and ill, and declined taking any more, though no other was supplied.

The German veterinarians believe in the danger of using such milk as food. Haubner alludes to its evil effects on young animals, particularly calves and swine ; and Röll mentions that the young of mothers affected with the disease are often attacked with enteritis, in consequence of the alteration the milk has undergone. He likewise adds that the use of

this fluid has produced a vesicular eruption in the mouth of people, as well as, according to Spinola, an interdigital vesicular exanthema ;* and states that the use of the milk and butter derived from diseased animals should not, perhaps, be permitted, except in those localities where the control of the epizoöty is confided to a special commission, or in which the inspection of animals and their flesh is entrusted to perfectly competent persons.

All authorities admit the harmlessness of the milk when it is boiled.

It is difficult to reconcile the conflicting opinions as to the propriety of permitting the milk of diseased animals to be utilized in an uncooked condition. If the statement of Lessona and others—that the milk is only dangerous when there are vesicles on the teats, and which, in the operation of milking, are broken and their contents mingle with that fluid—could be relied upon, then it should be interdicted in such cases; but as yet we require more proof.

If it be decided that the milk is to be permitted to be used as food, the authorities should make known the risk there is incurred, unless the milk is previously boiled.

So far as inspection of the milk is concerned, we have already alluded to its characters and peculiarities.

* Many cases have been cited within the last two or three years, but one of the most striking, perhaps, is alluded to in the *Recueil de Méd. Vétér.* for 1873, p. 577, in which, after inoculation through a sore, the mouth became affected and the toe-nails loosened. There was much fever.

GLANDERS AND FARCY.

SYNONYMS.—Greek : *μάλις, μάλεος, φαλχινίνα.* Latin : *Malleus, Equina nasalis, Equina apostimatos, Malleus humidus, Farcimina, Morbus farciminosus, Farcina equi.* French : *Morve et farcin, Farciminium* (from *farcimo*, to stuff, cram, fill full, surfeit), *Affection morveuse, Affection tuberculeuse, Affection farcino-morveuse, Diathèse morvo-farcineuse, Angéioleucite farcineuse.* German : *Steinrotz, Lungenrotz, Rotz und wurm der Pferde, Hautwurm, Hautrotz, Rotz dyskrasie.* Italian : *Morva, Moccio, Cimurro, Ciamorro, Ciamorco, Scabbia, Farcino.* Spanish : *Cimorra, Lamparones.*

GEOGRAPHICAL DISTRIBUTION.

Glanders and Farcy are probably widely diffused diseases, and have been known from the highest antiquity. It would appear, however, that some countries are more severely visited than others, and that they are those in which horses are most artificially maintained, and in which the laws of health are imperfectly observed or altogether ignored.

According to Liguistin,* the disease was unknown in Mexico until the war between that country and the United States of America, in 1847, when the troops of the latter introduced it into Vera Cruz. It, nevertheless, appears to be rare in its new home.

It is said to be unknown in the Australian colonies, and has not been as yet recognized in India, according to my inquiries, except as an imported disease, apparently generated on board ship, and among Australian horses, strange to say. The disease was very common among the animals carried to India from Abyssinia, after the war in the latter country, but it was soon got rid of. This immunity of horses in India is, in all

* "Journal de Méd. Vétérinaire Militaire," 1866, p. 433.

probability, largely due to the climate, as well as to their not being kept in close, overcrowded stables, but generally in sheds or the open air.

At the Cape of Good Hope it is not unfrequent; though it rarely assumes the acute form until after a considerable period. I have seen Glanders and Farcy cause much havoc among horses in North China, and have witnessed the disease in Pekin and at Tientsin, as well as at Shanghai.

France and Germany, and the Continent of Europe in general, are much ravaged by it.

CHARACTER.

It may be at once stated that the designations "Glanders and Farcy" are employed to distinguish two forms of one disease; or, in other words, that they are two diseases essentially identical, however dissimilar their external manifestations. They are the result of a peculiar diathesis, characterized externally by certain alterations in the skin and the mucous membranes of the respiratory passages of the head; consisting chiefly of ulcerations and the formation of a special kind of purulent matter, with inflammation of certain lymphatic vessels and glands, and induration of the latter.

The term "Glanders" is applied to the disease when the nasal or respiratory mucous membrane and adjacent lymphatic glands, as well as the lungs and other organs, are involved; and "Farcy," when the malady is localized in the skin and subcutaneous connective tissue, and secondarily in the lymphatic vessels and glands.

These two forms of the affection may be observed in the same animal singly, simultaneously, or successively, and the contagium of Glanders may produce Farcy by transmission from a diseased to a healthy animal, as Farcy may produce Glanders. Hence the name "Skin Glanders" (Hautrotz) given by the Germans to "Farcy," is perfectly applicable.

Experimentation has demonstrated that the morbid products of acute Glanders and Farcy, no matter from what organ or surface they are taken, give rise indifferently to one or the other form; and that the principal seat of the lesions of

acute Glanders, developed by inoculation, does not at all depend upon the source from which the inoculating material is derived; inoculation with the matter obtained from a glanderous pulmonary abscess may produce an infection in which the principal, and sometimes the only apparent, lesions are located in the nasal mucous membrane, and *vice versa;* and that derived from a cutaneous abscess of acute Farcy may occasion acute Glanders, in which the most marked alterations will perhaps be found in the lungs or nasal cavities, and *vice versa.* These facts prove that Glanders and Farcy are one and the same disease, no matter what organ, organs, or tissues appear to be more particularly affected.

NATURE.

Glanders and Farcy (viewing them as essentially identical) belong, then, to a special diathesis which, peculiar to the equine species (and in all probability to all solipeds), is only developed immediately in it; though it is capable of transmission to various other creatures, either by direct inoculation or by infection, being contagious, generally incurable, and, as a rule, fatal.

In addition to the widely diverse animals to which this contagious malady may be transmitted, mankind is also capable of receiving it.

It has been grouped with that class of diseases termed "granulomes," and defined as a malady having a tendency to the formation of granular cells and destructive processes. According to the intensity of the morbid process, there predominates the formation of these cells or those of the normal tissues.

The diathesis, whose existence is indicated by the above characteristics, appears to be closely related to some alteration in the nutrition of the tissues; as it may be developed by causes which operate in this manner. This diathesis in some of its features is allied to human Phthisis. Acute Glanders has been occasionally supposed to be merely the expression of purulent infection in the equine species, from the frequency

with which it has been observed to follow severe operations, purulent fevers, and inflamed blood-vessels.

CAUSES.

Of all the contagious maladies affecting man or the domesticated animals, perhaps Glanders is the disease which would be selected as an example of the spontaneous or direct development of a virulent or infecting element. Those who maintain that a contagious malady can never be generated, but that its appearance must depend on the presence of a previously existing germ, have had but little or no experience among horses or of this disease. The highest continental veterinary authorities, and those who have most attentively studied the etiology of the affection, are absolutely unanimous in their opinion as to its being at times developed directly, and without contagion having anything to do with it. The innumerable facts derived from many years' observation, afford perfectly conclusive evidence that, under the influence of certain causes of an appreciable character, Glanders will develop itself without the intervention of a contagium.

These causes are more or less of a kind that produce debility, and defective or perverted nutrition ; and in this respect the disease resembles human Typhus. We have it constantly produced where hygiènic measures are neglected, and the laws of health ignored ; and in localities or districts where it had not previously been seen, perhaps, for years. It is almost certain to break out among army horses during a campaign ; and in recent times, as in the Crimea, the Franco-Italian struggle with Austria, and in the Franco-German war, we have had ample proof of this. In the last-mentioned instance, the magnificent German cavalry that invaded France took the field after every care had been exercised that no glandered horses should be in the ranks ; and yet at the end of the campaign every regiment, it is reported, was more or less infected, the necessities and hardships of war having, as usual, engendered it. Their return to Germany spread the malady in that country to an unheard-of extent. According to the official reports of the government veterinary surgeons in Prussia, in 1871-72,

the number of cases of Glanders appears to have been no less than 1729; while in 1870-71 there were only 996 cases, and in 1869-70, 959 cases. This recrudescence is attributed by all the reporters to contagion; and especially to the fact, that on the return of the troops to Germany, the military authorities sold all the surplus horses, many of which were glandered or had cohabited with diseased animals. Except in those cases in which the malady had been imported from Poland by horse-dealers, it was universally recognized that the horses brought from France were infected, and carried the disorder with them. France did not fare much better, particularly on the Rhenish frontier; and since the departure of the invaders, Glanders and Farcy have been very prevalent. Our own experience in war time is to the same effect.*

During the Crimean war, Glanders was a common and most fatal disease; and in North China, among the Tartar ponies purchased at Shanghai, and intended for the operations towards Peking, I was compelled to order the destruction of the few that arrived at Talienwhan Bay, out of several hundreds, in consequence of their being all more or less infected with Glanders and Farcy. The officers in charge at Shanghai did not know the disease, and allowed the animals to perish without any measures of isolation, disinfection, or prevention of any kind.†

It is the same with the horses of large towns or large establishments: if these are suddenly called upon to undergo

* A very striking instance is afforded in what occurred during the expedition to Quiberon. The cavalry horses, which had been embarked free from disease, had not been long on board the transports, before it became necessary to close the hatchways during stormy weather. The consequence was that they were nearly suffocated, owing to the heat and foul air, and when they were disembarked not long afterwards most of them were affected with either Glanders or Farcy, or both. Similar occurrences are within my own knowledge and experience.

† It is worthy of note that the horses from India, where, as has been mentioned in speaking of the geographical distribution of the disease, it is scarcely, if at all known, were not affected with Glanders in North China. The Tartar ponies from Shanghai were not, of course, allowed near them, and every precaution was adopted.

severe exertion during bad weather, and upon an insufficient allowance of food, or forage of an unsuitable quality, the disease will, in all probability, not be long in showing itself. Excessive labour, not properly compensated for by food of a proper quality or in sufficient quantity, may be set down as one of the chief influences in operation to produce Glanders and Farcy.

Faulty ventilation of stables is also another cause; and during the last and at the commencement of this century, before veterinary science had been recognized in the British army, this disease committed terrible havoc among the troop horses, not only because the contagious nature of the disorder was not understood or was unappreciated, but also because stable management and the requirements of health were neglected. Now the malady is extremely rare.

Other causes are also in operation; in fact any cause, or combination of causes, that induces debility, will more or less lead to its development. Horses badly cared for, under-fed and overworked, kept in improper stables, exposed to severe weather, &c., not only develop it, but they are rendered more susceptible to the influence of the virulent element already generated; in this manner it becomes a wide-spread epizoöty at times.

Animals thus enfeebled or predisposed, if they do not chance to develop it immediately, are yet liable to do so in the course of Catarrhal affections of the respiratory mucous membrane, and particularly of the malignant form of Strangles. Glanders and Farcy, especially in the acute form, have also been observed to follow other long-standing diseases, especially Scabies (Mange); indeed, among troop horses during war, it is very often Scabies first and Glanders next.

When the disease has once been developed, of course contagion is then a well-known cause of its extension.

The diathesis is much more frequent in common or low-bred, than in high-bred horses.

SYMPTOMS.

Glanders and Farcy are each capable of assuming two states, chronic and acute, depending upon the virulence of the contagium (if the disease has been transmitted), or upon the general condition of the animals, and other circumstances. As it is important to distinguish both states, we will describe each of these forms of the disease in its chronic and acute manifestations, merely remarking that the chronic is generally more common than the acute.

1. *Chronic Glanders.*

This condition is rare among fine, highly-bred horses, but frequent in coarse, lymphatic, old, and worn-out animals. It may continue for months, and even years, and the animals may exhibit but little constitutional disturbance. The symptoms are local and general. The first are essential and constant, as well as contingent or accessory; the second consist of more or less fever, according to the period of the disease and the influencing circumstances.

The essential or characteristic local symptoms of chronic Glanders are the nasal discharge, ulceration of the pituitary membrane, and enlargement of the submaxillary lymphatic glands.

It usually commences with the signs of an ordinary acute or chronic Catarrh of the nasal passages, the discharge flowing from one or both nostrils, though most frequently the former. This discharge may be at first transparent, and at a later period opaque and viscid, collecting around the margin of the nostril, flowing slowly, or snorted out in lumpy masses; the discharge usually comes from the nostril in which the ulcers hereafter to be described are situated; if it is from both nostrils, then ulceration will be found in each of them. In exceptional cases there is no discharge, and this condition was designated by the old French hippopathologists as "dry Glanders" (*morve sèche*). It is extremely seldom, however, that it is entirely absent; and in nearly all of these cases, a very small quantity of a serous, slightly opaque fluid will be noticed flowing from the inferior commissure of one or both nostrils.

In the majority of instances, at the commencement it is trivial in quantity, and in all likelihood produced from the ulcers in the nostril: being only thrown out in a large and less characteristic quantity when the lining membrane is more or less inflamed, which frequently happens.

The character of the discharge is noteworthy. As has been said, it is glutinous and adheres to the skin and hair around the nostrils, forming soft, greasy-feeling crusts of a deep-brown colour, which adhere to the fingers when touched. At this period it is chiefly albuminous in its composition, but it afterwards becomes purulent; and then it assumes a peculiar slightly greenish tint which has long been looked upon as characteristic of the disease, and which does not disappear until the malady is of very long duration and the discharge is abundant.

In some cases, while preserving its particular viscosity, it has a slightly rusty tint, or is streaked with blood; this especially occurs when the disease is beginning to run a more rapid course and assume an acute type, and the ulcers in the nasal cavity are becoming more numerous and deeper. As a rule, the discharge is inodourless, or has only a faint sickly smell; at times, however, it is very fetid when it has been accumulated in the sinuses for some time, putrefying from contact with the air before being discharged; though this fetor is not absolutely distinctive of Glanders, irrespective of its other physical qualities.

The ulcerations on the membrane of the nose are of two kinds, as pointed out by Reynal: one kind consists of veritable chancres, and the other of simple destruction of the epithelium covering the membrane. Only a small portion of this membrane is visible without a particular examination and exploration, visually and by means of the finger; which inspection should always be carefully made by the veterinary surgeon (Professor Hering has invented a little reflecting apparatus for this purpose).

It will be found that the chancres of chronic Glanders are usually few in number and are seen in only one nostril: gene-

rally below the duplicature of the internal wing of the nostril, and on the extremity of the upper branch of the great turbinated bone, which appears to be their principal seat. It may happen, however, that they exist on both sides, and even over the whole extent of the nasal membrane visible during life—and beyond this at times, as a necroscopical examination will testify.

These chancres are at first discovered as little infiltrated or resisting points, or round "nodosities," developed in the texture of the membrane, about the size of a grain of millet or a small pea, and perfectly defined. When touched by the finger, these nodosities feel like a foreign body fixed in the membrane. When they are exclusively situated on the duplicature of the internal wing of the nostril, in rolling the latter on the thumb they are readily perceived, even without looking for them, owing to their hardness and definiteness. To the eye they appear as little hemispherical bodies of a yellowish colour, slightly projecting beyond the level of the membrane, which, at their margin, is pale and shining, or so inflamed as to form an areola around them, according to the progress of the disease, and the approach to the acute type. They are rapidly developed, often acquiring their maximum volume in a day.

In two or three days these nodosities liquefy; their centre becomes softened, and more white and opaque, and the epithelium covering them is detached, allowing a drop of pus to escape, and leaving a small concave depression. This is the first appearance of the glanderous chancre, and constitutes "confirmed glanders."

At the commencement, this depression or "sore" is somewhat circular, with a sharply-defined border, finely notched around its margin, and roughened at the bottom. It is of a dull or leaden-gray colour, sometimes streaked with small blood-coloured lines; and if the malady approaches the acute type, it becomes bright-red or violet-coloured. Invariably, there is observed around it a narrow, hard, slightly elevated circle, continuous with the fibroid base on which the chancre rests.

The chancre, once formed, continues to suppurate, and the

matter from it, sometimes considerable in quantity when compared with the size of the sore, not unfrequently coagulates and forms a yellow, but slightly attached crust over it. Not only does it persist without exhibiting the slightest tendency to cicatrize, but it continues to extend itself incessantly at its margin until it attains a good size; a number, if they happen to be near each other, may even coalesce, and form large rodent ulcers variable in shape and with festooned borders; though always characterized by their primitive appearance—that of a dove-tailed margin in an exuberant and indurated circle. In proportion as the ulcer enlarges, the induration of the mucous tissue becomes more extensive.

We have said that the chancre does not cicatrize; but this statement is scarcely correct, for in very rare circumstances it may do so; it then contracts, and is filled up by granulations, which finally become covered with epithelium: the whole process resulting in the production of a fibrous circular, or stellate patch, whose white colour is in striking contrast with that of the other portions of the membrane.

This cicatrization is probably due to a check in the progress of the malady, and to an effort of the organism to repair the effects of the disease; though it does not in any way indicate a perfect recovery, the chancre being merely the most superficial and characteristic expression of the diathesis, and not the fundamental lesion. When the ulcer has cicatrized in this manner, the tubercles still remain in the lungs and are never absorbed, and the entire body retains the virulent properties of the disease, which, although latent, will again become manifest at a future period by a second crop of chancres.

In addition to these chancres, there are frequently seen, in long-standing cases of Glanders, superficial erosions which the French have named *ulcerations larvées*, in consequence of their being scarcely visible and not easily recognized. These are very irregular patches, from which the epithelium has disappeared as if it had been scraped off; they are usually observed on the middle portion of the septum nasi, which is in this situation of a dull-red colour, has lost its shining appearance, and is at times partly covered with a purulent or pultaceous

matter that is easily removed by slight rubbing with the finger.

The third characteristic symptom of the disease consists in the alteration of the inter- or submaxillary lymphatic glands; whence is derived the farrier's designation of "glanders." This alteration is inseparable from the chancrous ulcers in the nose, and varies somewhat according to its age. One or both glands may be affected, according as one or both nostrils discharge and have ulcers; if only one nasal cavity is affected, then the gland on the corresponding side is involved.

The peculiarities of this alteration are as follows: the gland is elevated in the intermaxillary space, and its volume is increased in size from that of a chestnut to that of a small apple; it is most frequently elongated in shape from behind to before, though occasionally it is round; and one of its most marked characteristics is its being always irregular to the touch—lumpy and nodulated—over its surface. At first it is a little soft and doughy, and painful on manipulation; but in a few days this condition disappears, and it becomes hard and indurated, fixed to the subjacent organs by a fibrous pedicle, and perhaps also closely to the skin and jawbone; it is then indolent, and never softens to suppurate—indeed, the old French hippopathologists had a well-founded adage that the "gland" of this disease never suppurates; and rarely any kind of treatment except excision will remove the hard, resisting, insensible mass it forms.

The disease is at times accompanied or preceded by certain other alterations, which depend in some way on the morbid diathesis. These are sarcocele, inflammation and rheumatoid affections of the joints or sheaths of tendons, causing tumefaction of these and lameness, brittleness of the bones, œdema of dependent parts, epistaxis, cough, irregular respiration, and swelling of the sinuses of one side of the head; and their separate or collective presence may aid in distinguishing the disease when it is otherwise only suspected.

The general symptoms accompanying these changes are, in the majority of cases, obscure at first; there may be observed a certain amount of fever, debility, and unthriftiness, with

diminished appetite and loss of weight, increased temperature, &c., but when the appearances just described commence to manifest themselves, there is a striking recovery, apparently. The appetite is regained; the animal becomes lively, and improves in condition and general appearance, as if a crisis had been passed and recovery were assured. This deceptive state may continue for some months, and it is only in those cases in which the disease is localized in the lungs from the commencement, and generally when the malady is of long standing, that the animal continues to look ill and the above enumerated general symptoms persist.

Usually, notwithstanding the apparent healthiness or check to the disease, it goes on extending its ravages, and at more or less distant intervals is complicated by exacerbations, which promptly increase the lesions. Some of the exacerbations are at times so severe that the animal may die of chronic Glanders in a few days; indeed, the malady nearly always terminates in this manner, for its progress is generally all the more rapid the older it is, as if the acute type had suddenly appeared. Then we have metastasis, frequent cough and difficult breathing, œdematous infiltration of the extremities and dependent parts in general, or farcy tumours and ulcers in different regions; and, finally, death from marasmus, or the rapid formation of glanderous abscesses, accompanied by intense fever or pyœmia.

Though the character of the nasal discharge, the ulceration of the pituitary membrane, and the induration of the intermaxillary lymphatic glands may be justly designated distinctive indications of Glanders, particularly in the chronic form; yet it is by no means rare to meet with instances of what are termed "internal glanders," in which one or all of these symptoms are absent. In this form, after death the lungs may be found filled with numerous nodosities and tubercles, some in the gelatinous, others in the caseous, and others again even in the calcified condition, and varying in size from that of a pea to that of a nut. Similar masses are also met with in the liver, spleen, bronchial and mesenteric glands, &c. These cases are by far the most dangerous, as they offer no

symptoms which might lead the expert to suspect the existence of the malady, and yet they readily infect healthy horses; and there can be no doubt that it is such cases which maintain and propagate the disease in stables, in those instances in which outbreaks occur after sometimes long periods, and without any assignable cause. Such instances are common enough in this country, though the reason for their outbreak has only too often not been suspected; on the continent they are far from being unusual, and attention has been drawn to the subject by Saint-Cyr, Lafosse, Bouley, Zundel, and others.*

* Bouley mentions that Glanders recently prevailed on a large scale among the horses of the *petites voitures* of Paris, owing, it was imagined, to the increased speed demanded of them. The usual inspection of the horses was made by passing the hand between the branches of the lower jaw, and observing if there was any discharge from the nostrils; but nothing suspicious was noted, not even in the depots where the malady prevailed most severely; and in the absence of "glandage," as the tumefied gland is termed, and the nasal discharge, no further examination was made. Consequently, hygiènic conditions, hard work, bad food, &c., were put down as causes in producing and maintaining the disease. Bouley, however, though willing to give due weight to these, yet believed that contagion must have a large share in the development of the malady; he therefore proceeded to make a more minute inspection of all the horses, including a close examination of the nasal cavities. It was then discovered that in a depot containing 1000 to 1200 horses, there were about thirty whose pituitary membrane presented a variable number of white cicatrices, the irregular dissemination of which testified that they had been the seat of a pustular eruption; for they were depressed like those which succeed veritable pustules on the skin or mucous membrane; the pituitary of these animals was *grêlée*, as it were, like the skin of a pock-marked man. This was an important discovery, and other facts were not long in presenting themselves, giving to this appearance its real signification. In fact, in some horses which were at work, and which had neither "glandage" nor discharge, Glander pustules were found in the nostrils; these were either in process of evolution or already ulcerated, with their margin in relief and infiltrated with yellow serum, their centre being granular, of a bright red colour, and more or less concave. Some ulcers were covered with a non-adherent black crust, formed by the dried serosity and the dust from the forage. Generally few in number and isolated, these pustules had not given rise to any notable irritation of the mucous membrane supporting

2. *Acute Glanders.*

This form may be developed as a primary disorder, and, according to some authors, it appears as a secondary affection, complicating and terminating chronic Glanders; though Reynal denies this. The symptoms, as in the latter form, are general and local. The first indicate serious constitutional and functional disturbance, with intense fever, which lasts from two to four days; the appetite is impaired and capricious; there is depression and rapid emaciation; the coat is dry and unhealthy looking, notwithstanding careful grooming; the tem-

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them, nor to increased secretion: no abnormal amount of discharge issuing from the nostrils. By a somewhat remarkable peculiarity, as Bouley puts it, the pustular eruption was the exclusive character of this form of Glanders; for there was neither nasal discharge nor glandular enlargement. Another more striking peculiarity was noted, inasmuch as this form of the disease was *benignant* with the affected animal; so far, at least, that there was no apparent derangement of health or condition, nor impairment of the appetite; and recovery seemed possible, as was evidently proved by these thirty horses. One of the number which showed the eruption was put aside, in order that the course of the disease might be watched; and it was found that this was perfectly regular, the pustules cicatrizing and leaving the white depressed spots already mentioned.

Though apparently latent, this form was not really so, as the pustules were visible; and though it was benignant in the subjects it affected, it yet was sometimes powerfully malignant when transmitted, giving rise to the fully developed disease, with regard to the intensity of all the symptoms and the gravity of the nasal and visceral lesions.

So it was that all the horses it was found necessary to kill—and they were numerous—had all the symptoms of acute glanders, often in the most intense form, and frequently the cutaneous eruption extensively developed, with the most marked pulmonary and nasal lesions.

The careful observations of Bouley conclusively demonstrated that this concealed and unsuspected form of the malady was really the cause of the outbreak among the other horses; and the result of the measures adopted to suppress the contagion still further proved this to be the case, as the malady immediately ceased its ravages. In a few months, in an effective of 10,000 horses, the loss was indicated only by some rare units; while previously it had amounted to tens every month. The precautions consisted merely in an almost daily inspection of the nasal cavities of all the horses, and the immediate isolation of those which appeared in the least degree suspicious.

perature of the body is increased, being in the rectum as high as 109° Fahr. according to Trasbot. According to Brusasco, the temperature rises in a regular manner to 107° and 107·50°, and remains so for some days, with slight oscillations. In a less acute case, the exacerbations were more marked.

On the slightest exertion the animal perspires, and the subsequent lassitude is most marked, and induces prolonged resting; there are shiverings and tremblings, and perhaps sudden lameness without any perceptible cause. The urine is remarkably increased in quantity, and is clear and watery, often containing albumen; the breathing is hurried and irregular, the respirations numbering 40, 50, or even more per minute, and is not unfrequently accompanied by a snoring sound and dyspnœa, amounting almost to suffocation when they become more rapid and tumultuous; the heart's beats are strong and bounding, and coincide with a metallic tinkling; the pulse is small and quick, and the artery feels soft and flaccid. The visible mucous membranes are highly congested, and are at first of a saffron hue, but soon become darker coloured, and even violet when suffocation is imminent. The nasal membrane is intensely injected, and appears tumefied; sometimes there is hæmorrhage from it.

After two to four days, as already mentioned, the fever begins to diminish; and the local and essential, as well as accessory, lesions manifest themselves, their eruption coinciding with this marked—though ephemeral—decrease in the fever. Numerous Glander nodosities show themselves on the pituitary membrane in both nostrils; sometimes, and most frequently, they are disseminated on the septum and below the alæ of the nostrils, lying close to each other in a group; or they appear as diffused patches of a grayish-yellow colour, slightly raised above the surface of the membrane; the latter are the "glanderous infiltrations" of Leisering. Each node, considered separately, is about the size of a small seed or pea, grayish-white or yellow in its centre, and surrounded by a very bright-red areola. In about one or two days these bodies, as well as the diffused infiltrations, disaggregate by softening, and are thrown off, carrying with them the epithe-

lium that covered them, and leaving a deep chancre with ragged salient borders, which, as well as the bottom of the ulcer, have exuberant granulations of a reddish-violet hue that bleed when they are ever so lightly touched.

These chancres are numerous and irregular in shape, and quickly invade the membrane in breadth as well as in depth; in the majority of cases they soon finish by becoming confluent, and thus constitute vast ulcerating sores of various sizes and outline, which may penetrate to and expose the nasal cartilage: this soon being involved in necrosis, and presenting the peculiar green colour of mortification. If the animals live for several weeks (which they rarely do, as they soon die or are killed), this cartilage may become perforated, and then the two passages communicate directly with each other. The ulcerative process may even extend to the larynx and trachea.

With the development of the chancres, there also appears an abundant discharge from one or both nostrils; this discharge varies in character, according to the stage of the malady. At first it is usually a lymph-like, yellow, viscid fluid, the colour of which is not very different from that of the discharge at the commencement of Pneumonia; then it afterwards becomes more copious and thick, and altogether purulent, streaked with blood, or the colour of wine dregs, and hæmorrhage may also occur at intervals.

Tumefaction of the intermaxillary lymphatic glands—either one or both, according to the condition of the nostrils, but most frequently both—accompanies the evolution of the chancres. The gland is at first soft and movable, slightly infiltrated at its most dependent part, and painful when pressed upon. In a few days it is better defined and hard, and is not long in assuming all the characters already noted in chronic Glanders.

Farcy in an acute form nearly always complicates the disease, preceding, accompanying, or following it; and in addition to the lymphatic vessels becoming inflamed in other regions, we have those passing from the nostrils to the submaxillary glands corded and ulcerated. The alæ of the nostrils, and more rarely all the anterior part of the head,

suffer from œdema; and this, together with the always increasing infiltration of the nasal mucous membrane and the œdema taking place around the ulcers on the larynx, renders the respiration more and more difficult and stertorous, and the cough short, harsh, and painful.

Other complications ensue, such as intense inflammation of the synovial membrane of the joints, and other derangements. The fever, which had almost vanished when the eruption appeared, now increases; the animal is indifferent to what passes around it, and the feebleness is extreme; lobular Pneumonia, indicated by modifications in the respiratory sounds and the substitution of others, is not unfrequent, and the development of glanderous deposits in the lungs renders the respiration still more troubled; at the chest, abdomen, and prepuce or mammæ there is œdema; new ulcers are continually forming on the skin and pituitary membrane, and suppurate much; while the discharge from the nostrils is still more copious; the inflamed lung becomes infiltrated with pus and glanderous formations; emaciation is extremely rapid, and profuse diarrhœa often sets in at this period.

Death occurs in from eight to fifteen days from the appearance of the fever, and is due either to exhaustion, or to asphyxia when the larynx is severely involved (when a fatal termination may occur early), or in consequence of the lung disease.

3. *Chronic Farcy.*

This is the least serious, though it is the most frequent, form of the Farcino-glanderous diathesis, in consequence of the lesions being external and slow in their development. It most frequently attacks common-bred lymphatic horses, old, or exhausted by hard work. It is rarely observed in young, vigorous, well-bred animals, or in the ass or mule.

It is characterized by local, specific, or accessory symptoms, as well as indications of fever, which are often remittent, and nearly always so little marked and insignificant as to pass unperceived.

The local symptoms consist in the appearance of superficial indolent tumours, or "farcy buds," on the skin in various

parts of the body, and which soon ulcerate and become chancrous, constituting the specific feature of the malady. These tumours (French *boutons*, German *knoten*, *beulen*) are at first hemispherical, varying in size from that of a pea to that of a small nut, and are suddenly developed; the small are entirely cutaneous; the largest, however, are generally subcutaneous, and involve the connective tissue. Some commence to form altogether beneath the skin, which is only affected when they begin to ulcerate; and the superficial, as well as the deep-seated, may be isolated, generally diffused, clustered in groups, or confluent on a limited surface. In this case they are small and quite superficial, and extend over the body: though particular regions are more liable to their invasion than others, and generally where the skin is thinnest, most sensitive and vascular; this is the face, particularly around the eyes, nostrils, and lips, in the jugular space, inside the limbs, chest, upper part of the shoulders, flanks, inside the thighs, legs, abdomen, and sides of the chest, and near the root of the tail.

Their number varies greatly. Sometimes at first there is only one, then another appears, then a third and fourth, and afterwards a larger number, which develop successively and with a rapidity proportionate to the constitution of the animal and the severity of the attack; at other times they are thrown out nearly simultaneously, and in such numbers that the whole skin seems to be involved. In the first form, if the malady is allowed to pursue its own course, several weeks or months may elapse before many regions of the body are affected.

Once developed, these tumours soon become modified, and undergo certain changes, which invariably result in ulceration; though some may disappear and reappear in other parts. At first, each, considered separately, is a small hard body, so slightly projecting beyond the skin that it is more readily felt than seen; it is not very painful, though in some cases it is so, and is surrounded by a doughy swelling that insensibly disappears at its outer circumference. In one, two, or three days, the tumour has increased in height and

diameter, and the soft swelling surrounding it has become indurated and incorporated with it; its periphery is now well defined. As it extends in diameter, it commences to soften in the centre; so that in from four to ten days a fluctuating point is noticed there, which, if punctured, gives exit to a small quantity of very thin, yellow, oily-looking pus, the appearance of which is strikingly characteristic of the affection. If, instead of puncturing it, this tumour is allowed to ulcerate spontaneously, the centre gradually becomes more prominent and the circumference more salient and indurated; then the hair falls from the centre, the skin there has lost its vitality and becomes brown, and finally it ruptures by the pressure of the fluid beneath, or sloughs away as a small circular disc. In either case, the wound caused by this ulceration is the same in character; being regularly circular, slightly ragged and infiltrated at the margin, excavated into a concave cavity, and of a dirty-yellow or grayish hue, with the circumference and base indurated. The pus is somewhat abundant, and though possessing the characters already indicated, it frequently coagulates, and in drying agglutinates the surrounding hair: forming on the surface of the chancre a yellowish crust, sometimes of considerable thickness, that adheres but slightly to, though it conceals, it; through this crust the matter exudes and dries, giving it a scabrous aspect.

This Farcy ulcer has no tendency towards cicatrization like an ordinary sore; and, if not interfered with, it extends by destroying the tissue around its margin. If the chancres are numerous and confluent on a given part, the tissues separating them are rapidly eroded, and the result is a large, actively-suppurating ulcer, which may vary greatly in size and form. These confluent ulcerations are most irregular in outline on the upper part of the shoulder or neck, or the surface of a limb.

However irregular the shape of the resulting sore may be, its specific characteristics never fail; the quality of the pus, the peculiar jagged border, the surrounding induration and hard base, as well as the marked depression in the centre of the ulcer, are unmistakably diagnostic.

The time required for these changes to take place varies; when the chancres are quite superficial and limited to the skin alone, the period is comparatively more brief than when the tumours commence beneath the integument; in which case weeks may be required, though in both cases the results are the same.

At the same time, or immediately after the development of one or more "farcy buds," there begin to appear long, narrow, straight, or sinuous swellings, which stand more or less prominently from the skin in various regions of the body. These are the farcy "cords," and are really nothing more than inflamed lymphatic vessels. These subcutaneous vessels are most readily perceived when "corded" in certain situations: as the sides of the neck, shoulders, lateral parts of the body, inner aspect of the limbs, &c., they always commence and proceed from a farcy bud, to which their presence is due, and run towards the nearest lymphatic glands, where they terminate. The swelling they form is not always well defined at first, the subcutaneous infiltration surrounding them rather concealing their outline; but if the œdematous ridges are carefully felt, the hard round vessels are readily perceived. With the persistence of the inflammation and the absorption of the infiltration, in a few days they appear well defined, and larger in thickness than a goose quill; they are then uniformly hard and resisting, and everywhere painful on pressure.

The corded appearance of the vessels does not continue long; for there soon appear at certain distances along their course little enlargements, which give them a resemblance to a string of large hemispherical hard beads. These prominences soon soften and fluctuate in their centre, in the same way as did the primary "buds;" and, like them, they become ulcers, presenting the same peculiar chancrous appearance, and discharging the same oily-looking pus. Thus the "cord" is transformed into a chain of ulcers, which, in multiplying and eroding the tissues in every direction, sometimes terminate by coalescing, and thus give rise to a deep linear ulcer or furrow of more or less length, filled with pus; only interrupted in places by shreds of skin, and always tending to become wider

and deeper, the cases being quite exceptional in which granulations appear. Even then, cicatrization is often extremely slow; and the granulations, which may be exuberant, remain soft and spongy, and easily torn for a long time.

This is the most usual course pursued by the inflamed lymphatic vessels, or "cords," in chronic Farcy. Sometimes, however, when the disease is slower in its progress, they merely retain their cylindrical shape, without becoming monoliform; and becoming more and more indurated, at length gradually contract and maintain this condition for a very long time; should the primary "buds" from which they emanate disappear or cicatrize, they may even regain their normal state without softening and ulceration. This condition, which is very unfrequent, would appear to mark a check to the course of the malady, and lead to the hope that it was about to terminate in recovery; but in only too many instances it is merely temporary, and the disease again shows itself sooner or later.

The glandular indurations, or "glands," are tumours which become developed in consequence of inflammation attacking the lymphatic glands, and are a consequence of the "buds" and "cords." They are observed wherever these glands are situated: as in the intermaxillary space, and the axillæ and inguinal regions. At first they are surrounded by infiltrated cellular tissue, like the buds and cords, which rather masks their outline; but if the swelling be carefully felt, an irregular indurated mass, the size of a nut or small apple, painful on pressure, will be perceived in the middle of the infiltration; the latter disappears gradually as the gland becomes larger and more indurated, and assumes all the characters of the gland in chronic Glanders. It is lumpy on its surface, very hard, closely adherent to the neighbouring parts, but little painful, and persists for a very long time without increasing much in volume; it never suppurates nor ulcerates.

In the course of the disease, there are sometimes observed, in addition to these local lesions, certain contingent alterations which it may be well to note, and which chiefly consist in the formation of tumours and swellings.

The "farcy tumours" are not invariably present, but are, on the contrary, somewhat rare. They vary in size from a hen's egg to that of a man's fist; and at first hard and hot, soon soften, and persist for a long time as purulent cysts, discharging matter not unlike that already described as characteristic of Farcy. Their situation is always superficial, and as they are found in those parts most exposed to contusions, friction, &c., as on the sides, haunches, and croup, it has been considered that they are merely epiphenomena, largely due to accidental causes. They never exhibit any tendency to ulceration; appearing suddenly, they are at first hard, a little painful on manipulation, and always well defined; they do not extend, nor are they accompanied by peripheral infiltration; and they soften in a very rapid manner, though they have never been observed to open spontaneously. When punctured, a quantity of fluid corresponding to their size is discharged; this is thick, stringy, yellow, and like oil. When empty, the lips of the wound become glued together by the discharge, and in a very short time the pouch is again replenished; though the fluid finds an exit by its own weight, and is evacuated in long streams, which agglutinate the hair over which they pass, and form yellow crusts. In some cases, the secretion of pus is so abundant that the wound does not close, but becomes fistulous, remaining in this state for weeks or months; in others, after being punctured, the resulting wound rapidly heals, and the cyst remains as intact as if no opening had been made; and in others, again, after puncture, the application of a blister, or even if it has not been interfered with, the tumour gradually contracts and disappears, its walls adhering together, and cicatrization proceeding slowly from the margin towards the centre, leaving a subcutaneous induration which persists for a long time.

It would appear that these tumours or cysts differ in nothing from ordinary cysts, except in the character of their contents; which again depends upon the peculiar diathesis under whose influence the disease is produced.

The farcinous "swellings" are inflammatory in their nature, and appear on the limbs, most frequently the hind ones.

Sometimes they only surround an articulation, as that of the fetlock, hock, or knee ; at other times they occupy, from the commencement, nearly the whole of a limb, from its junction with the body to the hoof, and it is quite exceptional to see more than one leg so involved. The œdema is very great and completely deforms the limb, which is so painful that the animal endeavours by every means to avoid manipulation ; while there is considerable lameness and stiffness in movement, the leg being swung round or raised high in the air at every step. This lameness may show itself before the œdematous infiltration, and be due to a kind of arthralgia that very often coincides with the primary manifestations of the diathesis.

The symptoms of extreme pain that always accompany a farcinous engorgement are not usually of long duration, but in the course of a few days gradually subside, and disappear in two or three weeks, the engorgement, however, becoming more dense and indolent.

These swellings are by no means characteristic of the disease, and are not present in every case ; so that, like the cysts, they may be regarded as only contingent manifestations. In some cases, however, the presence of chancres, or "cords," on their surface indicates their otherwise doubtful nature. The latter are probably never absent, though their presence is concealed so frequently by the general swelling and œdema ; they appear very early, and immediately succeed the inflammatory infiltration, their usual situation being the inner surface of the limb, where the large veins and lymphatics are lodged. There they remain in a state of induration, and seldom ulcerate, unless they originate from a chancre.

When buds or chancres exist on the swelling, these cords may then be perceived running in every direction, to converge towards the lymphatic glands in the groin or axilla, and bear the special features already described.

The tumefaction of the limb, instead of becoming more indurated and persistent, may, within a few days, in very rare cases, suddenly disappear, leaving the limb all at once of its natural size and free from pain ; but this subsidence is only metatastic, for coincident with it an eruption of Glanders may

take place in the lungs or nasal cavities, accompanied by severe fever. In other instances, when the engorgement disappears, it is only very slowly; and in proportion to its rapidity of resolution, other more serious lesions manifest themselves internally, the indications of the malady being only translated from without to within.

The eruption of Farcy is, doubtless, always accompanied or preceded by fever; though when the disease is slowly developed this may be so slight as to be unperceived by ordinary observers, yet evident enough to the experienced veterinary surgeon, who recognizes it as identical in its manifestations with that of chronic Glanders.

Chronic Farcy is, then, characterized by "buds" or chancres on the skin, these yielding a peculiar pus; by swellings which may or may not be followed by ulceration of the contiguous lymphatic vessels; and non-suppurating, non-ulcerative indurations of the lymphatic glands in which the latter terminate.

3. *Acute Farcy.*

Acute, like chronic Farcy, is manifested by general and local symptoms; the former being more marked than in that type of the disease. Before the special local changes become apparent, the animal is observed to be out of its usual health, its appetite being diminished and capricious; and there are present all the other signs of general disturbance already enumerated as manifested in acute Glanders. With the evolution of the local symptoms, the more urgent indications of general trouble subside in from two to five days; the appetite returns, and the animal regains its usual spirits, and nearly all its former strength. But this apparent amelioration is, contrary to what is noted in chronic Farcy, of short duration; the fever soon re-appears, and the pathological changes become general and rapidly reach their last stage.

The Farcy "buds" are thrown out in considerable numbers, and quite suddenly, frequently becoming confluent on a limited surface; in the course of a single night even, they increase to the size of a large nut, softened in the centre, and ready to

ulcerate. In addition to being very hot and sensitive at their commencement, they are surrounded by the usual œdematous infiltration already described; but this, in the acute type, is wider, more diffused, and less defined, and may occupy a large surface. When the limbs are affected, there is nearly always an enormous and very painful swelling, which is developed before, or coincident with, the eruption of "buds," occupying the whole extremity, and causing the most intense lameness.

Each bud ulcerates towards the second or third day, the ulcer being wide and deep, and extends rapidly. The pus that escapes is abundant, viscid, and usually streaked with blood, or wine-coloured. The border and bottom of each chancre is covered with soft, exuberant, violet-coloured granulations, which break and bleed at the touch. The ulceration extends as rapidly as the eruption appeared; in a few days the chancres have become widened in every direction, and, if confluent, soon form large sores with irregular excavated borders, bright-red at some points, and covered with brown soft crusts in others: the whole constituting most unhealthy-looking wounds. Sometimes a fourth, or even one-half of the shoulder, one side of the head or neck, or a large space of some other region, is destroyed in this manner.

Coincident with these phenomena, "corded" lymphatics of large dimensions are developed between the ulcers and the lymphatic glands; these inflamed vessels are hot, œdematous, and painful, like the chancres and general swellings which immediately preceded them; they soon become nodulated, soft, and fluctuating, and, opening at numerous points, finally constitute a long ulcerous trench, from which a viscid, sanguinolent pus flows abundantly. At the same time, the lymphatic glands into which these vessels open, rapidly inflame and swell; they are extremely painful to the touch, and enveloped in a mass of inflammatory infiltration.

Notwithstanding the acute inflammation that takes place in them, like the essentially characteristic "gland" of Glanders, these glands do not suppurate, but, on the contrary, become more and more indurated.

Sometimes we find these ulcerations of the skin, and hypertrophy of the subcutaneous connective tissue of one or other of the posterior limbs, occurring without the formation of buds; at the places where they are about to appear there are observed one or more small points, gradually becoming prominent and fluctuating, and finally the skin thereon ruptures, and the characteristic ulcer remains.

When this part is examined after death, there is found in the skin and connective tissue a certain number of cavities, from the size of a pea to that of a nut, filled with yellowish-white gelatinous matter; some of these have already opened upon the skin, others are in process of doing so, and others again are deep-seated; while some are filled with inspissated pus, or the fibrous shell covers a mass of matter undergoing cretification.

In acute as in chronic Farcy, there are contingent symptoms which, though not present in every case, and therefore not of themselves characteristic, are important. These are: acute inflammation of the joints, with great and intensely painful swellings around them; and inflammatory œdema of dependent parts, as the lower portion of the chest, head, and limbs.

While these changes are going on, the hectic fever from which the animal suffers is intermittent, exacerbations occurring at varied intervals; and the unmistakable lesions of acute Glanders, already alluded to, show themselves in the nasal cavities, and testify to their presence in the lungs by their own particular symptoms. The animals rapidly lose condition (15 to 20 kilogrammes a-day in some cases, according to Reynal), sink into a state of extreme exhaustion, and die, if not destroyed before they reach this stage.

COURSE AND TERMINATIONS.

We have already pretty clearly described the course of Glanders and Farcy in enumerating their symptoms. Chronic Glanders and Farcy may continue for several months, and even years; but when sudden and acute, death is usually prompt. The prognosis of the disease is, therefore, unfavourable: the pretended cures and recoveries seldom, if ever,

bearing investigation. If horses suffering from chronic Farcy sometimes appear to recover, this is but temporary; as after a variable period of time—perhaps after several months —the malady re-appears and terminates fatally, as chronic or acute Glanders. Acute Glanders and Farcy, and particularly the former, cause death in from eight to fifteen days. In the former, death may occur in a shorter time from suffocation. The primary fever, which seems to abate when the eruption of chancres takes place, appears with renewed intensity, and new ulcers form in the nasal cavities and on the skin, and discharge abundantly; the lungs inflame, and are infiltrated with pus; and the horse perishes from hectic fever or obstructed respiration.

In the horse, Glanders generally appears in the chronic form; in the ass and mule, it is most frequently acute. Farcy, on the contrary, is oftenest acute in the horse; the chronic cases, according to Haubner, being only about 10 per cent. Bagge states that, in Copenhagen, of 1534 cases of the disease, 1366 were Glanders, and 168 Farcy; of these about one-eighth were acute; and in 1026 cases, 498 had the discharge from both nostrils, 271 from the right, and 257 from the left. In Saxony, according to Haubner, of 780 cases, 713 were Glanders, and 67 Farcy; the acute form varied from 3 to 12 per cent., or about one-eighth of the cases.

The relative frequency of Glanders and Farcy varies in different localities, no less than in different climates and breeds of horses. In Britain, the cases of Glanders would appear to be far more numerous than those of Farcy; and in the Camargue, France, according to Delorme, Farcy is most frequent, Glanders being somewhat rare.

Farcy would appear to be more common in coarse than in well-bred horses. In the French army, for example, this form of the disease is most frequent among the heavy horses of the artillery; while Glanders is far more prevalent in the cavalry.

It may be remarked that those cases of Farcy which have had their origin in contagion, and in which the malady is still localized, are not absolutely desperate, provided prompt medical treatment be adopted. With regard to Glanders, it is

only in cases in which, soon after contamination, the inoculated part can be deeply cauterized, that it is possible to prevent the development of the disease.

PATHOLOGICAL ANATOMY.

The pathological anatomy of this disease is very interesting, and demands a somewhat careful notice. We will, therefore, follow the same course in treating this section which we did in describing the two types of the malady.

1. *Chronic Glanders.*

The pathological anatomy of this form differs but little from that of acute Glanders, the separation of the two being merely arbitrary; so that one description would almost suffice for both.

Their essential lesions are most frequently localized in the respiratory apparatus, and those portions of the lymphatic system physiologically connected with it; though they may also be found in a great number of organs. These essential lesions are: tubercles, chancres, lymphatic cords, and glands.

The glanderous tubercles are always met with in considerable numbers in the lungs, and, according to Reynal, nowhere else. This authority asserts that certain little fibrous nodosities found sometimes in the spleen, liver, and perhaps other viscera, are not tubercles, because they have neither the same basis nor the same organization; they are only inflammatory productions, analogous to the alterations which take place in the pleuræ, peritoneum, &c., and which will be referred to presently.

The real tubercles are disseminated throughout the pulmonary tissue, from the surface, where they can be seen and touched through the pleura, to the roots of the lungs, where their presence is rendered evident to the touch in pressing the tissue between the fingers, when they feel like grit scattered in the substance of the organ. In the same lung they are invariably found of different ages, and offering particular physical characters, according to their stage of development: those which have reached maturity being incomparably larger

than the others, if the disease is chronic: apparently indicating that a long time before the malady manifested itself externally, the lungs were involved.

At first, these glanderous tubercles appear as little congested spherical spots of a reddish colour, but soon afterwards they are dark; these injected spots are observed to be the seat of an abundant serous infiltration, the tissue in which this inflammatory action takes place being free from the induration and hepatisation that marks ordinary inflammation. At a more advanced period, a scarcely visible grayish-white point appears in the middle of each of these; but this rapidly enlarges until it has acquired the dimensions of a grain of millet, or even larger, still preserving around it the inflamed or congested circle, but remaining continuous, or in direct contact with the surrounding tissue, and having its own vessels. When removed from the lung and examined, each of these bodies is observed to be a little spherical filamentous mass, somewhat elastic on its surface, not easily crushed, grayish-white in colour, and slightly translucid.

After a time this nodosity becomes denser, and its exterior becoming organized, forms a thin resisting fibrous envelope around it; while the inflamed arolea gradually contracts and disappears. At this period the tubercle is completely formed and destitute of vessels, and it is seen to be well-defined and limited, dense, and resisting to pressure, opaque in its centre, and surrounded by a wall that possesses the tenacity of ordinary fibrous tissue; though it is never encysted, this capsule being continuous with the adjacent connective tissue, and its own framework is composed of fine prolongations from the envelope, these crossing and intercrossing in every direction in its interior; so that the tubercle of Glanders is never entirely isolated from the proper tissue of the lung.

Having reached its full development, the tubercle submits to the metamorphoses to which such formations are usually liable, and which brings about its destruction should the animal live a sufficiently long time, and particularly if new lesions are not incessantly produced under the influence of the unknown cause which so perverts the nutritive powers.

These changes consist in granulo-adipose, or fatty, caseous, and cretaceous degeneration.

The two first alterations are marked by the opaque, fatty, or cheese-like aspect of the centre of the nodosity, and the matter to which this appearance is due may be enucleated from the capsule and easily squeezed between the fingers, as if it were a morsel of tallow or cheese. This central softening, as Reynal remarks, has no doubt led many to consider the tubercle as encysted: an error due to their studying the process of destruction, rather than that of its formation.

After the caseous degeneration, or even coincident with it, there is often deposited in the mass a quantity of calcareous matter, which notably modifies its consistence: this being found in the portion mixed up with the cheesy material, in the form of fine irregular particles that feel like sand; while in the capsule they are intimately blended with its tissue, and give it an almost bony hardness. This metamorphosis continues, until at length it has advanced so far that each tubercle appears as a round, very hard stone, which grates under the knife, and is cut with much difficulty. It must be observed, however, that this cretification of the Glander tubercle is not often witnessed, as it requires a long time to be effected; it is only observed in a few old animals which have lived for some years after the commencement of the disease.

These tubercles, as has been said, are universally diffused throughout the lungs; they are also found in the texture of the mucous membrane of the smaller bronchia and the submucous connective tissue, and, though more rarely, around the vessels.

The situation of the tubercle appears to modify its features. If it has for its base a small bronchus, its central portion is soft and composed of pus globules and mucous filaments, and at times ciliated and cylindrical epithelium.

The tubercle in the mucous membrane is manifested by a thickening, which gradually extends until it soon forms a complete ring encircling the entire tube, whose cavity is filled with the matter just described. Examined in the microscope by means of a low magnifying power, this heteroplastic tissue

appears granular; but if a fine section is magnified from 250 to 400 diameters, it is found that the elastic fibrous tissue—a continuation of the neighbouring connective tissue—composes a very dense network, in whose meshes are perceived three or four embryoplastic nuclei more or less developed, according to the age of the morbid tissue. If recently formed, they are small and regularly circular in shape; but later they are more voluminous, surrounded by a layer of protoplasm, and become somewhat elongated, so as to resemble fibro-plastic cells. The majority of these anatomical elements are, however, no further developed, as the vessels have disappeared; but the superficial layer is still fed by the neighbouring vessels, and, completing its organization, constitutes the resisting shell we have already described. In consequence of this circumstance, the elements in the deeper portion of the tubercle undergo that peculiar form of mortification, designated "necrobiosis" by Virchow; they become softened and granular, and finish by assuming the caseous consistency before mentioned, and break up into fine granules.

Those of very old date, and which have reached the cretaceous stage of degeneration, contain, mixed with these granules, very minute particles of calcareous matter: the capsule itself being infiltrated with these, and no longer showing any distinctly recognizable morphological elements.

According to Reynal, the tubercles developed beyond the bronchial tubes—as in the interlobular and subpleural connective tissue, along the arteries, &c., have at first a different disposition. Their proper tissue, instead of at first forming a ring around a bronchus, is collected into a small regular sphere; in other respects they have exactly the same histological characters, and submit to exactly the same metamorphoses. It is, indeed, extremely rare that the tubercles of Glanders suppurate or ulcerate.

The glanderous ulcers are of two kinds, as has been mentioned: those which are identical with the chancres of Farcy, and those due to the simple destruction of the epithelium.

The chancres proper are to be found on the pituitary membrane of the nasal septum and the turbinated bones, and most

frequently on one side; though they may exist on both sides, and even in the trachea. They are seldom, if ever, absent from the duplicature of the inner ala of the nostril, which appears to be their special point of election; sometimes they are isolated and few in number; at other times, on the contrary, they are placed in linear series, or grouped in considerable numbers on a limited surface. They are often disposed in this manner on the turbinated bones, the greater portion of which they cover; they are rarely observed in the sinuses.

At first, each chancre is represented by a little, round, well-defined nodule, about the size of a grain of millet or small pea, imbedded in the texture of the mucous membrane or the subjacent connective tissue, and to the touch feels like a hard body lying beneath the membrane. When the malady progresses slowly, the nodules are of a pale-yellow tint, much lighter than that of the membrane; and when it borders on the acute form, around each appears a slight areola of congestion and œdematous infiltration, more marked as the course of the disease is rapid; though in this case the primary œdema soon disappears, leaving the tubercle clearly defined on the membrane. At an early period, the nodules are composed of a light yellow or grayish-red gelatinous mass, which later becomes more dense, bright-gray in colour and translucid, and offers about the same resistance to traction as embryonic fibrous tissue. Still later, each nodule or tubercle shows a yellowish opaque point in its centre or most salient part; the epithelium covering it is swollen or has already disappeared, and this point is friable and pus-like. The more or less nasal catarrh which invariably exists on the diseased side, is always most marked around these nodules.

The last stage of the nodule is ulceration. The central portion becomes softened in consequence of a proliferation of pus cells, which are eliminated, and leave a cavity the size of a small pea—the "glander ulcer" or "chancre"—sharply cut in the membrane as if it had been stamped out by a punch; this is surrounded by a very narrow indurated border, and has a hard resisting base, the bottom being gray and unhealthy-looking: the character of the borders and centre being due to

the continual production of new cells, which are destroyed as soon as formed.

These Glander ulcers, instead of being isolated or disseminated, may lie near each other and coalesce by extension, or by the intervention of new tubercles, and form large irregular-shaped chancrous sores of different sizes, with the characteristic indurated border, and covered by a foul-looking crust. If the animal lives a certain time, these chancres may involve the entire thickness of the pituitary membrane, and also the submucous tissue; in some cases, the nasal cartilage and the bones may become the seat of cellular proliferation, and in their turn yield to the destructive process: the cartilage even being perforated, and the ulceration over the bones accompanied by the production of osteophytes. At this period the nasal discharge is most unhealthy in appearance, sometimes streaked with blood, has a fetid odour, and is flaky and grumous from the *detritus* of the membrane, cartilages, and bones. The same nodosities and ulcers are found in the larynx and trachea.

The nodosities in the pituitary membrane, and in that of the larynx and trachea, before and after ulceration, possess the same histological features as the pulmonary tubercles; the objective difference resulting from ulceration depending exclusively upon the fact, that the former are in communication with the exterior, and the softened centre of the nodule is eliminated, leaving a chancre whose granulations cannot restore the lost tissue; as if the serum of the pus thrown out on their surface were endowed with destructive properties, so far as their anatomical elements are concerned, and rendered all attempts at repair futile. Reynal has pointed this out, and states that the most superficial embryonic elements scraped from the bottom of the chancre, where they form a thin pultaceous layer, have their nuclei divided into four or five granules like all other dead cells.

When the pustules of Glanders are numerous in the nasal cavities, it rarely happens that the other parts—lungs, skin, &c., are seriously affected; and when the lungs are gravely implicated, the nasal cavities are ordinarily little involved.

In addition to the chancres proper, there are nearly always observed on the surface of the pituitary membrane in chronic Glanders, large superficial ulcerations, due to destruction of the epithelium ; often a wide surface of membrane is involved, and particularly on the septum.

The linear ridges, known to the French as the *cordes morveuses*, have as their base an inflamed lymphatic vessel that passes along the pituitary membrane, from the external orifice to the higher part of the nasal cavity, as well as above the intermaxillary glands. These cords are at first infiltrated, but this disappears, and the lines they form become more apparent ; if the finger is passed along the pituitary membrane, they feel hard and as if embedded in its deeper layers.

The intermaxillary and bronchial glands are also indurated.

The so-called "gland" of Glanders is not peculiar, anatomically, to the intermaxillary or sublingual glands ; for the lymphatic glands in Farcy are similarly involved, the situation constituting the only difference ; so that the same description of the pathological changes observed in the former will equally apply to these. These anatomical characters vary, according to the degree of development; but they are, nevertheless, essential lesions pertaining to the peculiar diathesis. At first there appears to be a certain amount of irritation set up in these glands, which at first sight does not seem to have anything of a specific nature ; they are enlarged from the size of a nut to that of a small apple, increasing slightly in length, and are soft and elastic to the touch. This enlargement is due to a proliferation of their cellular elements ; for in cutting into each cluster of glands, they are seen to be a little congested, and abundantly infiltrated by a nutritive blastema of a citron-yellow colour, that invades the surrounding connective tissue. Notwithstanding this evidently inflammatory condition, the tissue of the glands is not appreciably altered ; but, contrary to what takes place in ordinary inflammation, retains its elasticity and resistance as in a normal state. Two or three days after the commencement of this process, the glands have considerably increased in size, and become dense and resisting on

pressure, their outline being more defined, and their surface more lumpy. The bundles of vessels entering their deeper portion are inflamed and indurated, forming a kind of pedicle to which the glands are attached, and which fixes them to the tongue, and even to the corresponding branch of the inferior maxilla when the induration of the newly-formed connective tissue extends to the periosteum. A section of the tumour at this stage shows it to be composed of a multitude of very small cavities filled with a thick and viscid pus, that exudes in drops on the slightest pressure. Around these cavities, each of which is doubtless a suppurating follicle, the connective tissue is very vascular and thickened; while the afferent lymphatic vessels, when cut across and pressed, allow a yellow viscid pus to escape, like that found in the centre of the gland.

With the progress of the disease, the gland becomes more indurated, and so resisting that it grates under the knife when incised; the small cavities just described are surrounded by a more compact and less vascular fibrous substance, and the pus contained in them is inspissated, cheesy, and greasy to the touch. Far from following the usual course of an abscess, by extending peripherally, and joining with those around them to form a single cavity which will eventually open externally, each little space becomes contracted under the influence of the gradual induration of the intermediate tissue; while the elements it contains soon begin to submit to caseous degeneration, and if the animal lives sufficiently long, to calcareous infiltration: particles of mineral matter being found disseminated throughout the whole mass of the gland, as well as in the cavities.

A microscopical examination of the glands proves that the changes to which they have submitted are analogous to those which produced the pulmonary tubercles and the chancres on the skin and mucous membrane. At the same time that the cells forming the central mass of each follicle are multiplied to furnish the pus globules, the elements of the intermediate connective tissue enter into more active proliferation, under the influence of the irritating action of the altered lymph sur-

rounding them ; but as the embryo-plastic nuclei produced by this tissue receive their nutriment from the blood-vessels, their organization is completed, and they soon form around each purulent point a fibrous shell like that of the lung tubercle. The degeneration that takes place in the gland is identical with that occurring in the pulmonary tubercles.

In addition to these essential anatomical features of Glanders, there are lesions observed in different regions and textures, which are not absolutely characteristic, and which, while they are rather an effect of the malady, may be absent altogether in some cases. These contingent alterations consist in collections of pus in the sinuses of the head, induration of the pleura, pulmonary parenchyma, and some other viscera, and the general alterations due to anæmia. Of these occurrences, the purulent collections in the sinuses and the turbinated bones are the most frequent; they are, indeed, rarely absent if the animal has not been killed at an early stage of the disease. The quantity of pus varies, but sometimes it entirely fills these cavities, and its physical qualities are very different to those of pus formed as the result of ordinary inflammation. It is thick, viscid, and stringy, yellow in colour and generally odourless; and when examined microscopically, there are found in this fluid, the plasma of which is thick and very coagulable, a large number of cylindro-conical, ciliated epithelial cells derived from the mucous membrane, and comparatively few well-formed pus globules. The membrane lining the sinus is everywhere thickened from chronic inflammation, and though certain patches may be dull-looking, yet ulceration is never observed.

In long-standing cases of Glanders, there is sometimes a little transparent, almost colourless serum in the pleural cavity; and on the pleura itself, particularly the visceral layer, there are irregular white opaque patches, beneath which the membrane is thickened and indurated. In the lungs, particularly along the inferior border and anterior appendage of each lobe, there are more or less extensive patches of this kind, with badly defined borders, and studded with little purulent foci containing the fluid already mentioned as peculiar to Glanders.

In certain cases, there are also found in other viscera, such as the liver and spleen, and even the testicles, though rarely, some small rounded tumours the size of a pea or nut, yellowish-white in colour, and dense, with a softened centre, which some authorities have mistaken for tubercles; though neither in form nor anatomical structure have they any resemblance to these.

In very chronic cases of Glanders and Farcy, the blood is always more or less poor, the red globules being fewer in number, the white globules proportionately increased, and the plasma more fluid than in health. As a consequence of this anæmia, dropsical effusions into the connective tissue of the more dependent parts of the body—limbs, lower part of the chest and abdomen, &c.—occur.

2. *Acute Glanders.*

Similar lesions are found in this form of the disease. The pulmonary tubercles are, however, only found in their first or second stage, and a great number are merely small red spots disseminated on the surface or in the parenchyma of the organs, appearing like ecchymosed patches; though they are not due to interstitial hæmorrhage, but rather to congestion of the capillaries of the pulmonary tissue. Between the faintest of these red patches and the tubercle, every intermediate stage of the morbid process can be observed.

The chancres in the nasal cavities are generally very numerous, being frequently found in both sides, in the larynx, and also in the trachea. It is quite exceptional that the eruption is not confluent on one or more points of the pituitary membrane; this then appears highly inflamed, and is covered with small, white, and friable lenticular eminences which soon become purulent, and ulcerate into wide irregular sores, surrounded by prominent spongy granulations of a violet colour. There may even be hæmorrhagic extravasions beneath this membrane, often accompanied by bleeding from the nostrils, and tumefactions of an œdematous or solid character of the pituitary. When these swellings are very extensive, there are often developed fibroid elements, which are transformed into cicatricial tissue after destruction of the epithelium.

Apart from the superficial differences resulting from this acute inflammatory condition, the histological features of the alteration are absolutely the same as in the chronic form.

In the sinuses and turbinated bones the pus is usually thick, viscid, mixed with fibro-albuminous flakes, and streaks of blood from around the chancres and the surface of the mucous membrane ; while the latter is not unfrequently transformed into a callous tuberous mass.

The subglossal glands are surrounded by a yellow-coloured infiltration, and their tissue is very congested, though but little indurated.

Lobular Pneumonia is an almost constant accompaniment of acute Glanders, and has often been erroneously designated metastatic abscesses ; while at other times, the alterations resulting from the inflammation have been confounded with commencing tuberculization. A large number of the lobules may be inflamed, the inflammatory process involving a considerable portion of the pulmonary tissue. Each forms a mass from the size of a nut to that of an apple, in which the parenchyma is at first completely hepatized, of a dull dark-red colour, friable and granular in its texture, and heavier than water. A few days after this period, small multiple purulent centres appear in the middle of the mass, which soon unite to form a single cavity, the pus they contain being red-coloured and full of the *débris* resulting from the breaking up of the lung tissue. Sometimes there are observed the remains of interstitial hæmorrhage in and around these abscesses, which are not metastatic, but merely the termination of the lobular Pneumonia.

In very acute cases, the entire lung may be inflamed, and filled with dark-coloured viscid blood, as in asphyxia.

This lobular Pneumonia, it must be remembered, is not at all characteristic of acute Glanders, being merely an epiphenomenon ; it not unfrequently appears as a complication of other diseases, such as "strangles."

The blood in acute Glanders coagulates more rapidly than in health, and yields a large proportion of red clot : a circumstance not to be attributed to an increase in the number of red

globules, for these are relatively fewer than the white globules: the latter being, instead of about 1-300th part of the whole, 1-100th, 1-50th, and even more, forming sometimes a yellowish-white layer on the surface of the red clot. This is the character the blood offers during life, or when the animal has been sacrificed during the course of the malady. But when it is allowed to die, in addition to the predominance of white globules, it has assumed the same appearance that it presents in cases of asphyxia, being tarry-looking, viscid, and not disposed to coagulate.

3. *Chronic Farcy.*

The "bud" of Farcy—its chief characteristic—is an inflammatory tumour of variable dimensions, lodged in the skin and subcutaneous connective tissue, lenticular in form, and composed of the same elements as the Glander nodules. The centre and periphery have not the same physical characters; the first, about the size of a grain of millet or a pea, is dense, compact, and yellow, and possesses little vascularity, like the embryonic connective tissue produced by some abnormal irritation. Its tenacity gradually diminishes; it becomes friable, and appears white and opaque. The periphery is formed by an infiltration of citron-tinted fluid into the connective tissue, which increases the thickness of the skin, and has no absolute limit either towards the centre or with the surrounding healthy integument; soon the induration which was confined to the centre of the "bud" becomes extended to this infiltration, and the denser substituted tissue is also of a bright-red colour as it increases in vascularity. Within from forty-eight hours to three days after its appearance, the contour of the "bud" is well defined, in consequence of this progressive induration. If cut into at this period, the centre is found to be softened in consequence of the degeneration of the fundamental tissue; and in consequence of this liquefaction, there exists a small cavity containing the characteristic oily yellow pus, which is at times streaked with blood; there may at first be several of these cavities in the tumour, but they soon all unite to form one. This softening gradually extends in depth and breadth,

until nearly the whole of the tumour is involved ; and there is then a comparatively large cavity limited by a reddish-gray wall, more or less vascular, according to the rapidity of the disease, beyond which is a marked fibrous induration. Up to this period there is nothing very specific in the nature of the process, beyond what may be observed in an ordinary small abscess. Nevertheless, when the bud has ulcerated, and its contents have escaped, the sore does not heal again, but remains stationary ; or even slowly, but indefinitely, extends itself, without exhibiting the slightest tendency to cicatrization ; its margin being surrounded by a circle of induration that increases as ulceration progresses, the Farcy chancre at the same time resting on a fibrous indurated base.

Histologically, this chancre, in its earlier period, offers nothing beyond the characters of inflammation. The initial phenomena consist merely in the enlargement of nuclei in the cutaneous connective tissue, and their increased proliferation ; this is evidenced in the central portion by the presence of embryo plastic elements, which constitute the greater part of the new tissue. Beyond this point, there is a zone where the enlarged nuclei yet surrounded by a granular nutritive blastema, coagulated by the indurating fluid, commence to divide ; and in the outermost zone is only seen this same exudation, which fills and distends the meshes of the normal tissue.

At a later stage, when the " bud " is about to open, in consequence of the softening of its central portion, the pus found in its cavity contains but few distinct elements, and these offer nothing characteristic. Besides the ordinary pus cells, there are a few red globules either intact or wrinkled, and in process of disintegration ; as well as a considerable quantity of gray granules which dissolve in acetic acid and glycerine, and other refrangent fat granules which are not soluble in these agents. The serum of the pus is very abundant, proportionately, and thick, and immediately coagulates into a granular, solid, and yellow mass on the addition of any acid, especially picric acid. The walls of the cavity, after it has opened, are composed of the ordinary embyro-plastic tissue of inflammation, and on their free surface, in the leaden-gray spongy granulations which

form the suppurating layer, the embryonic elements offer noteworthy features. Instead of containing a well-developed nucleus filling nearly the whole cell, as in the elements of healthy granulations, the majority of the nuclei are broken up into opaque granules which look like necrosed particles: as if the abundant fluid given out by the capillaries destroyed them before they reached their full development. This, it has been suggested, may be the reason for the gradual extension of the ulceration.

The "cord" of Farcy has always for its base a lymphatic vessel; and in a purely anatomical point of view, the process to which it owes its appearance is merely lymphangitis. At first, this vessel is distended by an exceptional superabundance of lymph; the latter is troubled, white, or opaline, and thicker than usual. Outside the vessel, the connective tissue is infiltrated with the ordinary citron-coloured fluid to some extent. As the malady progresses, so do the pathological changes; the lymph becomes purulent, and contains little fibro-albuminous clots; while the vessel itself gradually enlarges, its walls are thickened and dense, and confounded with the surrounding tissue, which, at first œdematous, also becomes thickened and indurated. The interior of the vessel has no longer the smooth white appearance of its normal condition, but has lost its endothelium, is reddened, vascularized, and granular in patches, or throughout its whole length. The fluid within it, when examined microscopically, is found to contain numerous granular opaque leucocytes, shreds of endothelium detached from the serous membrane, and a large quantity of free granules. The serum, like that of the chancres, is very coagulable.

At a later period, the vessel is metamorphosed into a fistulous passage, with hard resisting walls; it may be completely closed, or studded along its course with numerous ulcers, which have all the characters of the primary chancres. These ulcers may also coalesce, and so at length form a deep ulcerous groove in the midst of a thick hard cord of yellowish-red fibroid tissue, which is more or less vascular, according to the rapidity with which the pathological changes are effected.

These changes are, histologically, of the same inflammatory kind observed in the formation of the chancres: the induration being due to the development of embryo-plastic and fibro-plastic elements.

With regard to the inflamed and indurated glands, the morbid process set up in them differs in no respect, anatomically, from that described in the intermaxillary glands; the only variation being their situation, which again depends upon the position the integumentary chancre occupies.

There is nothing particular to note in the pathological anatomy of the superficial tumours or cysts which have been alluded to as contingent symptoms of Farcy, and the same may be said of the swellings which occur during the course of this disease; these are at first of the usual œdematous character noted in ordinary inflammation, the connective tissue primarily infiltrated becoming, after a time, indurated to such an extent as to grate under the knife. In the midst of this tissue are frequently found small collections of the usual characteristic pus; and if the animal is allowed to exist sufficiently long, ulceration may take place in the abscess.

The lungs usually contain, in chronic cases of Farcy, the specific tubercles in various stages of development, the pituitary membrane being often studded with ulcers.

The pathological anatomy of acute does not differ in any essential particular from that of chronic Farcy; the only features of dissimilarity being due to the higher degree of inflammation that marks the progress of the former.*

* Virchow, according to Röll, was the first, in his *Handbuch der Spec. Path. u. Therapie*, vol. ii. p. 408, to declare that the glanderous nodosities proceed essentially from cellular proliferation; and that although with regard to their anatomical characters and the ulterior changes taking place in them, they are intimately related to the tubercle proper, yet the cells of Glanders are more allied to those of pus than of tubercle. Rawitsch, in Virchow's *Archives* (1862, p. 33), has shown the differences that exist between the elements of tubercle and the glanderous neoplasia; while Forster, in his *Special Pathological Anatomy* (2nd edit., p. 336), also admits that the two nodular formations are not identical. Leisering, in the *Report on Veterinary Science in Saxony* (1862, p. 121), publishes the results of his extensive and minute researches, and also decides as

DIAGNOSIS.

The differential diagnosis of Glanders, particularly the *chronic form*, can only be fully established after ascertaining the existence of the three characteristic features which we have described as peculiar to the disease, but especially the presence of the nodosities and ulcers in the nasal cavities. The nature of the morbid condition which gives rise to a discharge of an unhealthy nature and unfavourable aspect from the nostrils, as well as tumefaction of the intermaxillary glands, must always, if these are not present, remain doubtful; as a chronic Catarrh of these cavities, of the sinuses or guttural pouches, new formations in the nasal mucous membrane, &c., may occasion these symptoms. In such doubtful cases, great care must be exercised in examining the suspected animal frequently and minutely, particularly the nasal cavities, and observing it for a sufficiently long period.* Inocu-

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to the specific character of the Glander neoplasia, which, consequently, cannot be identified with any other. Virchow (*Pathological Tumours*), classes Glanders and Farcy among the granulation tumours—among those neoplasiæ which belong to the conjunctival or connective tissue tumours; which, without ever producing perfect connective tissue, are especially composed of elements that are ephemeral in their existence. With these tumours, disintegration is the final and inevitable result; they assume an inflammatory character, all the more marked when their production is due to a general morbid diathesis. Röll considers that, taking into account the morphological differences between the tubercle proper and the nodule of Glanders and Farcy, the latter differ essentially from tuberculosis; and that it is therefore just to separate them, and to consider the Glander neoplasia, which is identical with that of Farcy, as a formation *sui generis*. The description which we have given of the pathological anatomy of Glanders and Farcy, is mainly based on the excellent observations of Reynal.

* We have already alluded to a chronic form of Glanders which has been designated "internal," from its presenting itself in a masked form, and without any very marked external symptoms. The expert, called in to decide upon an outbreak of this disease, and the cause for its maintenance and propagation, cannot be too careful in his examinations of even the unsuspected animals. Many outbreaks persist for months, and even years, owing to horses affected with this occult form being allowed,

lation may be resorted to, to test the innocuousness or virulency of the discharge, the animal itself being inoculated in

through lack of knowledge, to remain alive and associate with others. Regiments of cavalry, batteries of artillery, omnibus, cab, and other establishments, have been so haunted and ravaged for sometimes long periods, and the records of such events are numerous. We may, however, limit ourselves to a notice of the following recent cases, which have been related by Zundel.

Jarmer, of Leignitz, reported that, for two years, cases of Glanders were frequent on an estate in Silesia, without any assignable cause, and a number of horses were destroyed in consequence; when it was decided to kill an old horse, though not for Glanders, but because it was useless from what appeared to be Asthma. It was examined after death, when the lungs were found to be studded with miliary tubercles, which, by their caseous degeneration and calcification, showed that the animal had been affected with Glanders for a long time. With the death of this horse the disease disappeared from the stables.

Zundel states, that for some years Glanders prevailed extensively among the horses of a miller at Oltingen (Haut-Rhin), and caused much destruction, without any one being able to discover whence the infection came, slaughter of the diseased and careful disinfection producing no diminution in the losses. Zundel being called upon to consult with the veterinary surgeon who had the horses in medical charge, an inspection took place; when in the stud was found a horse whose emaciation and unhealthy-looking coat gave rise to suspicion, though no external sign of Glanders could be detected. The owner consented to have this animal killed, and at the autopsy the lungs were discovered to be filled with soft, indurated, gelatinous, and caseous tubercles, some recent, others quite old. Evidently this horse was glandered, and, in tracing its history, it was ascertained that one of its former owners, a butcher, had perished from a disease which the doctor of Rodersdorf (Switzerland), had declared to be Glanders and Farcy. Thus it happened that a horse which, externally, gave no indication of the malady, yet infected a man and six horses. After it had been slaughtered no other cases occurred at the mill.

The next instance was observed at Mulhouse, in the stables of a man who had lost several horses from Glanders. Zundel found in his possession an old horse which had neither ulceration, discharge, nor enlarged gland, but which, after it had been killed, had its lungs studded with tubercles: undoubtedly the cause of the outbreak, for with the death of the animal the malady ceased in the establishment.

In the middle of October, 1873, Zundel had three horses destroyed, which had neither enlarged gland nor nasal flux, but only some little more or less ulcerated eminences in the nostrils. Their lungs, liver, and spleen, &c., were filled with tubercles of different sizes, and in various

those parts of the body where the skin is thinnest and most plentifully supplied with lymphatics; or another horse of little value, or better still, an ass, may be resorted to for this operation, the nasal membrane being inoculated by preference. Trepanation of the frontal sinuses and antrum Highmori has been recommended by Haubner, in suspicious cases; as in 75 to 95 per cent. of the glandered horses observed, there is disease of the mucous membrane lining these cavities. If the animals are really glandered, there are seen on this membrane nodosities with an irregular surface, such as have been already described; these new formations are generally developed in large numbers after the operation, sometimes filling the entire space, and usually invading the lips of the wound. Even when the membrane is perfectly smooth when trepanation is performed, the characteristic formations are not long in appearing if the horse is really affected with Glanders. The same alteration is noted after tracheotomy has been performed to relieve the breathing, when the mucous membrane of the larynx is involved in a like manner.

The character of the node or ulceration, the peculiar discharge and tumefaction of the intermaxillary glands, as well as the history of the case, if it can be procured, are generally sufficient to establish a distinction between this and other diseases.*

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stages. Two of these horses had been sold in the previous August by the German military administration, as healthy. One of them, in which Zundel had first recognized the signs of Glanders only four days previously, had nevertheless infected its companion five weeks before. An autopsy proved that the disease was of long standing in the first animal, while in the second the pulmonary tubercles were surrounded by a red circle.

It was Zundel's opinion that this form of Glanders could be easily masked by submitting a suspected horse to medical treatment, and especially to a course of arsenic. The external symptoms are made to disappear—the animal is, as it were, whitewashed—but the internal malady remains in all its virulence.

Percivall, in his *Hippopathology*, gives an excellent illustration of this occult form of Glanders and its dangers.

* The expert has, of course, to be on his guard in examining horses, in

The ordinary maladies with which it might be confounded are nasal Gleet or chronic Coryza, Œzena, collections of matter in the sinuses due to caries of either or all of the three last upper molars, matter in the guttural pouches, cancer of the bones of the face, malignant or asthenic and benignant "strangles." These maladies and conditions, however, though some of them may resemble in several features chronic Glanders, yet cannot be mistaken for it by the expert, who, if at first in doubt, will defer giving a decided opinion for a few days.

Too much circumspection cannot be observed in doubtful cases; for there are numerous instances which prove that the three leading or classical symptoms may be absent, or only

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order to ascertain whether or not they are affected with Glanders; as a low class of horse-dealers often resort to such artifices as plugging the nostril, and extirpating the diseased gland to conceal the presence of the malady. Veterinary surgeons are often deceived in this manner, and a case which occurred at Gravesend in June, 1874, afforded a most marked instance of this fact. A horse in the possession of a knacker, and employed to draw a cab, had been sold for a very small sum from a stable in which several horses had died of, or been destroyed for, Glanders; it was pronounced glandered by two veterinary surgeons who had known the animal for some time, and were perfectly acquainted with its history, as it had been affected with a discharge, for some nine months, from one of its nostrils. The corporation of the town took up the case, in view of the great danger horse-owners were exposed to, and the knacker was summoned. Two veterinary surgeons, who knew nothing of the animal, were employed by the owner, and pronounced it free from Glanders. Another veterinary surgeon was then called in, who, after a few minutes' examination, decided that it was not affected with that disease, and the prosecution was consequently defeated. I was requested to examine the animal, though not officially, at the same time as the gentleman whose evidence decided the case; and I found that all the discharge from the nostrils had been most carefully removed, and the submaxillary glands extirpated long before, only a small indurated portion remaining, with about half a dozen cicatrices marking the seat of operation. The horse had also a cough, and the lungs betrayed evidence of tubercular disease, which was supposed to be only "broken-wind" (Asthma) by the defendant's witnesses. There could scarcely exist a doubt as to the horse being affected with Glanders. Experts should not be so easily deceived by men who are notorious for their unscrupulousness and dishonesty.

one present: as, for instance, an intermittent discharge—and yet the animal can be affected with serious glanderous disease of the lungs and respiratory mucous membrane. The ulcer, if alone present, is characteristic of Glanders; but in the majority of cases there is the closest correlation between it and the indurated gland—the latter appearing to be the necessary satellite of the former; so that, as a rule, these two symptoms are coincident. But there may be only the indurated gland or the nasal discharge. The result of treatment, while the horse is kept under observation, will aid in diagnosing the disease; as a cure will in all probability be effected if Glanders is not present. The history of the case, careful auscultation, the condition of the animal, the existence of cough, erosions of the pituitary membrane, a peculiar roughness of the membrane lining the inner wing of the nostril and the inferior portion of the turbinated bone, ulceration of the mucous follicles, intermittent epistaxis, lameness at times of one or more limbs,—these are all more or less valuable aids in arriving at a conclusion as to the existence of the disease.

The *diagnosis* of *acute Glanders* is more easy, as it is accompanied by such serious and characteristic symptoms that a mistake can scarcely be made. Malignant Strangles has sometimes caused suspicion of acute Glanders, its complications not unfrequently presenting symptoms not unlike those of that malady. A careful examination of the ulcers and the discharge will, however, avert mistakes in this respect. The same may be said of Horse-pox and facial Lymphangitis.

With regard to *chronic Farcy*, when it is accompanied by all the symptoms we have mentioned, there can be no mistake; and, as in Glanders, the presence of the three characteristic and unequivocal features should afford ample evidence of its existence. In some instances, nevertheless, as Reynal points out, the disease commences by, and exists for several days merely in the form of, a swollen leg, and this alone would not suffice to establish its presence. No doubt, if the engorgement takes place suddenly, if it is very painful on manipulation and causes great lameness, and if, in addition, the animal is old and debilitated, Farcy may be apprehended; but nothing

positive can be arrived at until the appearance of the essential symptoms, which are not long in being developed. So that a definite opinion should not be given until these have manifested themselves.

The diseases for which chronic Farcy may sometimes be mistaken by the inexperienced, are "horse-pox," "lymphangitis" resulting from various local injuries, "simple œdema," and what Reynal designates "elephantiastic fibroma" of the limbs.

With regard to "horse-pox," in consequence of the rapidity of its evolution, it should not be confounded with chronic Farcy, but rather with the acute form, the distinction from which will be presently noticed: merely observing here that a few days' delay in deciding will prevent any mistake, the sores resulting from Horse-pox cicatrizing spontaneously after a short time.

Inflammation of the lymphatics due to contusions, wounds, diseases of the feet, &c., has often been considered as allied to, or identical with, Farcy; and this mistake has doubtless led many authorities to consider the latter as a curable disease, some giving the recoveries as 80 per cent. and even more. Simple local Lymphangitis is sometimes observed after injury to the withers or back of the head, sinuous cords being seen passing from the injury; these are merely inflamed lymphatic vessels. In injuries and diseases of the feet, similar appearances are often observed on the inner aspect of the limbs, from the foot or fetlock to the axilla or groin; and at the first glance they might be mistaken for the inflamed lymphatics of Farcy. But they have not a chancrous ulcer for their base, and merely arise from an inflamed spot, an abscess in process of formation, or a simple wound; neither have they the knotted indurated feel of the Farcy cord, and if opened their contents are thick, white, and cream-like, differing completely from the peculiar fluid contained in them in Farcy. The glands these vessels enter are not in the least indurated, but are sometimes only swollen, painful when pressed, and after a certain period suppurate—a result that never occurs in the Farcy gland. Simple treatment, such as fomentations or a poultice, will

generally in a few hours lead to the dispersion of these cords, if they have been recently formed and are not suppurating.

Swelling of the limbs produced by violent exertion, twists, sprains, muscular injuries, &c., accompanied by heat, pain, and much lameness, simulate, to a certain extent, one of the manifestations of the Farcy diathesis, and more particularly if one or more abscesses form and the lymphatics in the vicinity inflame. But the absence of "buds" and ulcers characteristic of Farcy will distingush such a case at once; though a day or two may be necessary to decide in a positive manner, should the chancres not be present. Exploratory punctures might, nevertheless, be made, in order to ascertain if there is any pus deep-seated; the character of this will distinguish the nature of the affection.

Chronic Lymphangitis or "elephantiastic fibroma," in which the subcutaneous connective tissue is hypertrophied and indurated, and which gives a strange deformed appearance to the limb, cannot be mistaken for Farcy; as its uniform and invariable density, complete insensibility, and slow but continuous increase, as well as the absence of buds and chancres, should distinguish it.

The characteristic Farcy knot and ulcer, the peculiar pus, and the glandular induration, are distinctive features of the virulent disease.

The diagnosis of acute Farcy is yet more easy, as these specific characters are still more marked. Two or three diseases may, however, at their commencement resemble Farcy. Acute Lymphangitis (vulgarly known as "weed"), which suddenly attacks one of the hinder extremities, and is accompanied by infiltration of the subcutaneous connective tissue, swelling, pain on manipulation, fever, excessive lameness, inflammation of the larger lymphatic vessels inside the leg, and tumefaction of the glands in the inguinal region, is one of these. But the special features of Farcy are absent, and in such a case a day or two will be sufficient to decide the question.

The same may be said of the œdematous tumours which appear at the commencement of Anasarca and subcutaneous Cellulitis.

When Horse-pox is complicated with Lymphangitis and the formation of pus, there may exist a suspicion of the presence of Farcy; as there may be pustules on the face and in the nasal cavities, with enlargement of the lymphatic vessels and glands. The aspect of the sores, which are never chancrous, their tendency to cicatrize speedily and spontaneously, the character of the pus, and the disappearance of the glandular tumefaction, differentiate this complication from Farcy.*

In all these instances, if there exists any doubt as to the presence of Farcy after careful examination, the animal's antecedents should be inquired into, in order to ascertain if it has before exhibited the same or similar symptoms, how it has been managed, whether it has been stabled or in contact with diseased or suspected horses, &c., and as a last resource, inoculation may be tried.

CONTAGIUM.

The two forms of this disease being transmissible, owing to the presence of a contagium which indifferently produces both, we have now to inquire into the character of this virulent element, whose presence was for a long time denied. This contagium is usually present in the *fixed* form; evidence as to its volatility not yet being sufficiently strong to warrant the assertion that it is always so, notwithstanding the weight of certain recorded cases of transmission. It is certain that the contagium is not volatile in chronic Glanders and Farcy; and

* In the autumn of 1873, while engaged in the military manœuvres at Cannock Chase, Staffordshire, I observed that horses picketed in the low ground near the River Trent were extremely annoyed by a small variety of dipterous insect, which fastened itself on the skin lining the ears, that between the fore and hind legs, but more particularly on that of the prepuce and mammæ, where it caused much local irritation during its feast of blood; and, subsequently, the absorbent vessels inside the thighs and mammæ, or in the neighbourhood of the prepuce, were inflamed and painful, a yellow cohesive discharge accumulated along their course, and small unhealthy-looking sores appeared in large numbers. Of course the cause of this condition was evident, and the wounds readily healed on being dressed with tar ointment, which also prevented the attack of the insects.

even in those instances which have been adduced to prove its volatility, we find that transmission occurred in close, hot, and confined stables where there were one or more diseased animals, and was most probably due, if not to direct contact, to the contagious matter being carried by the air, as it is known pus may be so transported.

The contagium exists in its greatest virulency, perhaps, in the nasal discharge, that from the ulcers of Glanders and Farcy, and also, as Viborg has long ago proved, in the blood and different secretions of the diseased animals. The last mentioned fact has been repeatedly demonstrated by those fatal and accidental inoculations in persons who, while dissecting the bodies of diseased horses, and taking every precaution against being soiled by the nasal and chancre discharges, have chanced to wound themselves by splinters of bone, &c.

The very remarkable and interesting series of experiments conducted by Renault, at the Alfort Veterinary School, with regard to the contagiousness of this disease, places this fact beyond dispute. Four horses were inoculated with scrapings from the centre of the healthiest-looking muscles of an acutely glandered animal, and they became affected with the disease. The same result was obtained in two instances, by inoculating with the matter obtained by scraping, with the back of a scalpel, the surface of fresh bones belonging to horses that had died from the malady.

The transfusion into the veins of three horses, of a certain quantity (four to ten décilitres) of blood from the jugular vein of animals affected with acute Glanders, rapidly produced the disease.* Acute Glanders has also been speedily developed in healthy horses, by injecting into their veins very small quantities of the pus of acute Glanders, diluted with eight to sixteen times its volume of water at the temperature of the body. These experiments also demonstrated that various secretions, obtained as pure as possible—saliva, bile, urine, and the aqueous humour—and immediately inoculated in healthy

* Professor Coleman was the first to satisfactorily demonstrate that the virus exists in the blood, by transfusing that of a glandered horse to an ass which, in four or five days, exhibited symptoms of acute Glanders.

animals, will not induce the disease; while the inoculation of five horses with synovia, spermatic fluid, and the serum of the tunica vaginalis, collected with the same care from horses affected with acute Glanders, have been successful: these secretions being derived from organs or membranes which are most frequently affected in the course of the disease. The pus from wounds or setons was also found to have as virulent properties as the nasal or Farcy ulcer discharge.

The infecting element is present at an early period in the progress of the disease—certainly as soon as the lymphatic glands become tumefied or other organs are affected—as soon, in fact, as the Glander or Farcy dyscrasia is developed. Its potency varies in degree, as does the disease itself; in acute Glanders and Farcy it is most virulent, this virulency nearly always coinciding with the existence of fever, and increasing as the malady becomes more aggravated, diminishing as apparent recovery takes place, though its power is never entirely subdued. Therefore it is that, if accompanied by fever, chronic Glanders is markedly contagious. Erdt and other German authorities have called attention to the important fact that horses are capable of infecting, though the most characteristic symptoms of Glanders are absent at certain periods, and only appear at such seasons as the spring and summer as a slight nasal discharge. Bouley, Lafosse, and other French authorities also refer to similar instances. Viborg describes such cases as "occult glanders" (*versteckten Rotz*); and it may be mentioned that Jessen of Dorpat successfully inoculated with glander tubercle from a horse in which no other indications of the disease were apparent. It may also be noted that Bagge found in fifty-three horses which, during life, appeared to be healthy, glander tubercles in the lungs, and isolated ulcers in the trachea.* It is extremely probable

* Is the glanderous diathesis hereditary? In this country, so far as I am aware, we have no evidence for or against the proposition; but there are some instances on record which might lead to the inference that it was so. Dupuy, for instance, mentions the case of a mare which, while affected with Glanders, gave birth to a foal that, when four and a-half years old, died of this disease without having been exposed to infection, so far as

that, in these cases, the infecting element was present, and is not remarkably virulent at a given moment, yet that it might be so at another. But we have already alluded to this when describing the symptoms of Glanders.

The potency of the contagium of acute Glanders is not diminished by repeated transmission. In a number of experiments undertaken by Renault, it was found that the virus obtained from a horse suffering from spontaneous acute Glanders, when inoculated in a healthy horse, produced the acute disease in it; matter from this animal was employed to inoculate another horse, and the same form was produced; the experiment ceasing at the tenth transmission, which was as energetic and complete as the first.

It would also appear, as the result of six inoculations made with virus obtained from persons who had become affected with Glanders from diseased horses, that the contagium acquires a more intense energy in passing through the human body; the disease produced in the animals so inoculated running its course much more rapidly, and the consequent lesions being much greater, than in any of the experiments made with the virus of acute Glanders obtained from infected horses.*

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could be ascertained. Another mare and her foal offered the same organic lesions on being opened, and in a third instance these alterations were observed. Latour alludes to an instance in which a foal from a glandered mare had, at birth, a discharge from the nostrils and enlargement of the submaxillary glands, and ten days afterwards ulcers on the pituitary membrane. It had to be destroyed. Liégeard has reported the case of a glandered foal from a diseased dam; and Lafosse has witnessed two mules and four foals, aged from eight days to three months, suffering from Glanders like their parents: though this veterinarian admits that he could not convince himself that they were diseased at birth, but might have acquired the malady through contagion after that event. This authority had three glandered mares destroyed, which were in foal for from six to nine months, and could find no trace of Glanders in the fœtuses.

* Many excellent typical cases of this disease in the human subject are on record; but one of the most interesting and instructive, from a comparative pathologist's point of view, was reported by Dr. Coupland in the *Medical Times and Gazette* for October 5, 1872.

VITALITY OF THE VIRUS.

The vital resistance of the virus of this disease would appear to be somewhat considerable. The medium in which it is contained may, when exposed to external influences, be dried in the air and kept for a long period, without losing its infective power when again rendered fluid by water. In favourable circumstances, its vitality may be maintained for several months, and even years. In experiments at Alfort, it has been found effective after six weeks; and there are many instances on record of horses becoming infected in stables in which the disease prevailed six and twelve months before.

It has to be noted that Viborg and Gerlach found the glander virus ineffective after a few days' drying in the air; but then it may have become decomposed through putrefaction; for Renault and Bouley have produced acute Farcy by inoculating with the nasal mucus of a glandered horse, this mucus having been dried and kept for six weeks. Boiling water destroys its activity, as it does the virus of other contagious maladies. So does air and light, and different chemical substances.

INFECTION.

This disease is transmissible from solipeds to various species of animals; though all do not exhibit the same aptitude for its reception. As a rule, nearly all horses have, naturally, a marked predisposition for the reception of the contagium of Glanders at all times; nevertheless, exceptions are not uncommon in which horses do not manifest this aptitude, and will cohabit with infected subjects—standing between them in the stable, and working beside them all day for months—without becoming diseased. Even in some instances experimental inoculation will fail; while, coincidently, the same matter will produce the malady in other horses in from seven to fourteen days.

With regard to species, it is established that mankind, dogs, sheep, goats, rabbits, and mice can be successfully inoculated.

Next to the equine and asinine species (in which the malady runs its course most rapidly), with regard to susceptibility, comes the feline, canine, and the human species. The sheep has also a notable receptivity for the contagium; the goat not so great; and the ox least of all the domesticated animals, with the exception of the pig.

The receptivity of the dog is not very great; indeed, not many years ago inoculations with glander virus were so unsuccessful in this animal, that it was believed it could not be infected. Hertwig made experiments for several years, but they were always incomplete in their results. He fed eight dogs for a number of weeks on the raw flesh of glandered horses, but without producing the disease in them. At first, however, they were usually affected with diarrhœa, the fæces being of a dark-red colour. Nordström produced the malady in two dogs by feeding them with this flesh; they had a bloody discharge from the nostrils, redness of the eyes, and an œdematous swelling of the head; they died.*

Lafosse mentions the case of a dog belonging to Marshal Neil, which contracted the malady through living in the same stable with a diseased horse. Hertwig applied the nasal discharge from glandered horses to the Schneiderian membrane of six dogs, by means of a small brush; in two or three days this membrane became swollen and dark-coloured, and there was a thin glutinous discharge, with moderate tumefaction of the submaxillary lymphatic glands. When the matter was inoculated on the skin of the forehead (where the animal could not lick the wounds), in two or three days there was swelling of the eyes, redness of the conjunctivæ, and tumefaction of the submaxillary glands. The wound inflamed, suppurated for about eight days, and then a black crust forming over it, it healed in from twenty to twenty-five days.

Of six dogs inoculated by Renault, two became affected. One of these perished three and a-half months after the local development of the disease; but the other only died in the fifth month. The successful inoculation of two horses with the

* Tidskrift for Veterinairer, &c., Stockholm, 1862.

virus obtained from the ulcers of these dogs, left no doubt as to the nature of the malady, which appeared in a most acute form.

Polli, of Milan, has induced the disease in dogs, by depositing the virus in wounds or injecting it into the circulation; the effects were always apparent, but their intensity and gravity varied according to the mode of introduction. Prinz, Andral, Burguières, Letenneur, Leblanc, Rayer, Saussier, and Saint-Cyr * have obtained results similar to those of Renault; Lafosse has also several times successfully inoculated dogs with the Glander and Farcy virus. And Decroix, from the result of his experiments, came to the conclusion that acute and chronic Glanders are transmissible to the carnivora by inoculation.†

Some of the larger carnivora, such as the lion, have received the disease through consuming the flesh of glandered horses.

* The results of inoculations practised upon seven dogs with Glander matter, by Saint-Cyr, of the Lyons Veterinary School, are summed up as follows :

1. Glanders is not the exclusive appanage of solipeds ;

2. It can certainly be transmitted to other animals, and especially the dog, by inoculation ;

3. In the dog, as in the horse, it manifests itself by inflammation and ulceration of the inoculated wound, swelling of the lymphatic glands in its vicinity, and nasal discharge. Chancrous ulcers are, if not always, at least generally absent ;

4. Glanders in the dog is generally remarkably benignant, and except in those cases in which it has been injected into the circulation, it is perhaps seldom fatal ;

5. Notwithstanding this marked benignity of "canine glanders," the virus none the less preserves all its activity, and when retransmitted to the horse, inevitably produces the malady in as marked a form as when passed direct from horse to horse ;

6. Lastly, Glanders in the dog, as in the horse, appears to be governed by the "law of unicity ;" for with the horse actually glandered, and the dog successfully inoculated for the first time, inoculation with the most active Glander virus produces no effect. This conclusion, however, requires more experiments to corroborate it.—*Journal de Méd. Vét. de Lyon*, 1866. p. 307.

† *Journal de Méd. Vét. Militaire*, 1863.

With regard to sheep and goats, Gerlach has proved that the former are very susceptible. In two cases, inoculation on the left side of the chest produced a glander-ulcer in five and six days; and in one of them death from Glanders was the result. In another instance, there was a fatal termination; and in a third, the sheep succumbed to the fully-developed disease seven months after inoculation. In the latter was found a deep glander-ulcer in the nostril, which at one point had eaten through the septum; the submaxillary glands were indurated, and on section exhibited infiltration with miliary tubercles. With matter from the ulcer a horse was inoculated; on the sixth day, at the point of inoculation, there was a glander-ulcer, and on the ninth day all the symptoms of Glanders were fully developed. The same veterinarian inoculated a young goat four times without effect.

Hertwig inoculated four sheep and three goats at the Berlin Veterinary School; but only one of the latter became affected. The virus in this case was obtained from a horse suffering from acute Glanders, and was introduced into the Schneiderian membrane and the skin of the throat. Within twenty-four hours after inoculation, there was intense inflammation of the nasal membrane and the inoculated skin; in forty-eight hours the head and throat were greatly swollen and painful, and there was much febrile disturbance, with the characteristic nasal discharge which, on the sixth day, was fœtid and mixed with blood. The loss of condition was very rapid, and on the sixth day diarrhœa set in, the matter being a brownish, foul-smelling fluid; the part of the neck which had been inoculated became spachelous, and on the eleventh day the goat died. Extensive infiltrations of yellowish fluid were found in the connective tissue of the head and throat, as well as in the cavity of the chest; there was also tumefaction of the lymphatic glands and vessels, and a number of yellow tubercles in the lungs. The Schneiderian membrane was of a dark-red colour, very swollen and spongy, with a number of small yellowish elevations, nearly all of which had a little white ulcer-spot in the centre, and a few contained a grayish-yellow matter.

The unsuccessful inoculations only showed an ephemeral inflammation where the punctures had been made, with the formation of a thin crust, the wound healing in about fourteen days. The animals were kept under observation for two and three months, without any symptoms of the malady being observed.* Hering could not account for this non-success.

Wirth inoculated a ten-months' old goat in three places on the under side of the tail, with virus from the nostril of a horse affected with chronic Glanders; on the fourth day the inoculation began to take effect at the wound; from the fifth day there was a loss of appetite, with fever, great prostration and emaciation, and a glutinous discharge from the nostrils. On the fourteenth day after inoculation the animal died. Besides extensive ulceration on the tail, a great many tubercles of various sizes were found in the lungs, with tumefaction and softening of the nasal membrane, and other appearances simulating typhus fever.†

Ercolani reports that a she-goat which was kept in a stable where five glandered horses had been lodged for fifteen months, was affected with inflammation of the udder, and the formation of an abscess in that gland; in ten days the animal was seized with general illness, discharge from the nostrils, and sniffling breathing. In ten days more it died; when glander-ulcers were found in the nostrils, pus in the submaxillary glands, and small tubercles in the lungs.

Renault inoculated four sheep and a goat. The latter and three of the sheep had glander-ulcers in the nose, and tubercles in the lungs, and died in a few days. As a proof that it was really Glanders which destroyed them, the matter taken from the ulcers of each of these animals produced acute Glanders in horses inoculated with it.

So little disposed is the bovine species for the action of the contagium, that on the Continent cattle have been permitted to associate with glandered horses without any apprehension of their becoming infected. And Hertwig has kept glandered

* "Magazin für die Gesammte Thierheilkunde," 1874, p. 119.

† "Archiv fur Thierheilkunde," 1844, p. 22.

horses among cattle for from five to eight months, without the disease being transmitted. The same authority inoculated five cattle with only partial success in one case. This was a four months' old calf, which had a chancrous ulcer the size of an ordinary bean on the nasal mucous membrane, and a hard, knotty swelling of the submaxillary lymphatic glands, nine days after inoculation with the nasal discharge from a horse suffering from chronic Glanders. Both these symptoms remained localized, and the ulcer healed in thirty-three days, leaving an uneven, irregular-shaped cicatrix. This animal was killed when eight months old, and no trace of the inoculation could be found in any organ—the lungs being free from miliary and other tubercles.

Of the other four cases, one was inoculated in the nostril and three in the skin; but there only appeared at the wounds a yellowish-brown, thin crust, which disappeared in six to eight days without any subsequent effects being observed.*

Gerlach unsuccessfully inoculated three cattle;† and with three cows and four fowls inoculated by Gerlach the same result was noted.

Viborg has fed pigs with the flesh of glandered horses, and caused them to cohabit and feed with animals in every stage of the disease, without their evincing any symptoms of the malady.

Renault inoculated five pigs with the virus of acute Glanders at different times, and in the thinnest portions of the skin, precautions being taken for some days that the scarifications should not be rubbed; but the latter quickly healed up, and nothing was observed.

Gerlach inoculated three young pigs, and only one of them had an insignificant affection of the lymphatic glands, which disappeared in a few days.

Lafosse has never been successful in his experiments with cattle.

Ercolani and Bassi have communicated the disease to mice, and Schilling to rabbits.

* Op. cit.

† "Jahresbericht der K. Thierarzreischule zu Hannover," 1869, p. 121.

MODE OF INFECTION.

Infection occurs immediately; *i.e.*, by contact with a carrier of the contagium: as a diseased animal; or mediately, by objects charged with, or soiled by the contagious material: such as harness, wood-work of railway waggons, stables, cleaning instruments (as brushes, currycombs, &c.), water-troughs, forage, and other vehicles. Renault's experiments showed that a horse may safely cohabit with one suffering from acute Glanders, provided the locality is healthy, that the distance between the two ensures their not coming in contact, and that care is taken to prevent the transmission, from the diseased to the sound, of morbid excretions from the nose or skin. This statement is founded on six experiments, in which healthy horses were made to cohabit with diseased ones for at least six days, and were afterwards carefully watched for not less than forty-seven days, then killed and examined.

In fifteen experiments of cohabitation, with direct and permanent relations between horses suffering from acute Glanders and others which were sound, it was found that in nine instances Glanders was developed in a period varying from seven to eighteen days after the commencement of the experiments; in six instances no bad results followed from the cohabitation, as a long time was allowed to elapse afterwards, and the animals were then killed and examined.

It was also demonstrated that the leather and hempen head-collars, and woollen and linen clothing worn by horses affected with acute Glanders or Farcy, until the moment of their death, when perfectly dried, but without being washed or fumigated, and worn by healthy horses, did not produce the disease either locally or generally. Eight carefully conducted experiments were undertaken to settle this question.* It was likewise shown, in nine instances, that the dung and urine voided naturally by glandered horses, and obtained from their intestines and bladder immediately after their death, did not occasion the

* Gohier, however, mentions that the halters and clothing of glandered horses were worn by two horses, a mule, and three asses, for from six to fourteen days; and that one of the asses showed symptoms of the disease on the fourth day, and perished on the sixth. The others escaped infection.

disease when applied to the surface of the body, or placed beneath the skin at the same time.

Of one hundred and thirty-eight horses cohabiting in Germany (according to Hering) with diseased animals, feeding and drinking with them, cleaned with the same brushes, and wearing the same harness, only twenty-nine (or twenty-one per cent.) became affected. Bagge also informs us that of one hundred and seven horses exposed to infection, thirty-one (or about thirty per cent.) escaped.

With Farcy, the infection is much less readily communicated than with Glanders, only about thirty per cent. of the inoculated cases being successful, according to Bagge and Haubner; and Zundel states that perhaps not one per cent. may become affected through simple cohabitation; but this, of course, will depend on the opportunities for contact between the diseased and healthy.

MODE OF ACCESS.

The parts of the body by which the contagium is usually introduced into the blood in ordinary circumstances, are the nasal mucous membrane and the skin; access may take place through these, even if they are intact, although it is much more certain if they are abraded. Experiments have been made with a view to decide this question, and it has been discovered that when a certain quantity of the virus of acute Glanders or Farcy is merely deposited on a cutaneous or mucous surface, it sometimes produces Glanders or Farcy, either locally or generally, and more certainly if these parts are thin; but if the matter is applied with friction, so as to soften or remove the epithelium, the disease is developed in the majority of the animals experimented upon. Renault and Chauveau have been very successful in this way.

The absorption of the virus appears to take place rapidly. Vogeli relates an instance in which, notwithstanding immediate washing of the infected wound with chloride of lime and other chemical fluids, Glanders afterwards became developed, with all its local and general symptoms. Renault's experiments also demonstrate that cauterization of the wound, though practised within an hour after infection, will not hinder the evolution of the malady.

With regard to its access by the air-passages, through the medium of the air expired by a diseased horse, though certain observations tend to prove that such a mode of contamination is probable, yet experiments have only yielded negative results. Renault, during a course of experimentation for more than twenty years, never succeeded in infecting a healthy horse through the medium of the atmosphere, even when it was closely confined in stables in which the malady prevailed. At the Alfort Veterinary School, he has kept such horses for months beside those affected with Glanders in every stage, but of course without permitting actual contact, and yet no conveyance of the disease by the air occurred. To demonstrate that the disease, even in its most acute form, is not communicable in this way, he compelled healthy horses to breathe the expired air of those whose disease was more particularly concentrated in the nasal cavities, by means of a long funnel made of impermeable material, the ends being attached to a kind of muzzle fixed on each animal's head. This exposure took place every day for one or two hours during six, seven, or more days, being repeated with the same or different sick animals, but always with those in which the disease was most malignant, every care being taken at the same time to prevent contact; and yet none of the animals so exposed became diseased.

Nevertheless, strikingly conclusive though these experiments appear to be, we cannot positively conclude that the contagium may not obtain access in this way. We have seen that a certain degree of aptitude or receptivity must exist, even in inoculated animals, to allow of the development of the malady, and this aptitude may not have been present in the Alfort horses. With enfeebled, aged, and predisposed horses kept in close hot stables beside, but not in contact with, those affected with acute Glanders, the result might be different. And may the poison not be given off by the skin and carried to a certain distance by the air?

Although at one time it was believed that the poison could not be received through the agency of the digestive organs,*

* It must be acknowledged, however, that Garsault, so long ago as 1770, was of opinion that infection could be produced by healthy horses licking the discharges from a glandered animal.

experiments have some years ago undeniably shown that contamination may take place in this way, even when the direct application of the Glander virus to a thin mucous membrane has proved unsuccessful. The disease has been produced by giving the glanderous matter in draught and in bolus.

Hamon, the director of the Veterinary School of Abouzabel, in Egypt, has witnessed dogs and a lion in the Viceroy of Egypt's menagerie, die from Glanders from eating the flesh of a sick horse. And Lafosse and Dulac saw a lion perish at Luchon, in 1864, from this malady induced in the same way. Towards the end of 1873, a splendid lion and tiger died from Glanders, induced by eating infected flesh, in the Zoological Gardens at Berlin. Saint-Bel and Spinola have reported the death of dogs, cats, and other animals from eating the blood, pus, or flesh of diseased horses; and a Zoological Garden in Germany for several years sustained a serious loss in its collection of carnivorous creatures, through feeding them on the *débris* (uncooked) of glandered solipeds. The stomach can, therefore, no longer be considered as capable of destroying the virulency of the Glander virus, and there can scarcely be a doubt that infection by the food and water occurs more frequently than might be suspected.

Inoculation is of course a ready means of producing the disease in a healthy animal, as the poison quickly enters the blood; it is also more certain in yielding successful results than any other. Nevertheless, as was before remarked, the contagium is not very certain in its effect when introduced in this way, immunity being maintained in a number of instances. Thus, in some researches suggested by a military commission in France, it was found that of ten horses inoculated with the virus of chronic Glanders, only four became affected; and of nine inoculated with that of the acute form, but three proved successful.

INCUBATION.

The period of incubation varies not only in different animals and under different circumstances, but also according to the

mode in which the contagium has obtained access. After inoculation with Glander virus, the latent term is generally from three to eight days, according to Röll, and five to seven according to Haubner, or even from ten to fifteen days; while the course of the malady is generally acute. In twenty-seven experiments made by Lafosse (six acute cases and twenty-one chronic), he found it to vary between four and twenty days. This result coincided with that arrived at by Gohier and other veterinarians. If infection has been incurred in the ordinary way, the incubatory stage is longer, and the symptoms may not develop themselves for weeks, or even months.

As a general rule, in ordinary infection the duration is from one to three, and sometimes as many as six weeks; and in isolated cases it has been observed to be protracted to three, six, nine, and even more months. In the case of an ass, cited by Gohier, which became affected by cohabitation with a glandered horse, the latent period was fifty-eight days. And in Germany and France, after the late war, instances are recorded in which this interval appears to have been more than a year.

It has to be noted, however, that these unusually long periods of incubation must have been frequently more apparent than real, the disease having developed itself some time before the expiry of this period, though not in a very marked manner. In some cases the malady may also have been so slight, or has shown such a tendency to recovery, that it has not been looked upon as Glanders or Farcy at all. In such instances, Farcy "buds" may have been present in the skin, or the Glander pustule* in the nasal cavities, together with the peculiar discharge; and yet these might temporarily disappear for a time, the complete and non-evanescent symptoms only developing themselves several months afterwards; thus giving rise to the belief in a protracted incubation of from six to eighteen months. These apparent and temporary recoveries are often designated "cures" by people who do not understand the disease.

* The term "pustule" is, though employed here, nevertheless incorrect when applied to designate the Glander nodule.

The latent period may be diminished by accidental or other causes, and the evolution of the malady accelerated. Excessive fatigue, due to severe exertion; a sudden chill; bad food; foul air—anything, in fact, that may momentarily disturb the regular performance of the chief organic functions, will abbreviate this stage. In order to develop the disease quickly, when infection is suspected, and thus guard against danger, it has long been the practice to bleed the animal, or give it a strong dose of purgative medicine. Wounds, the actual cautery, the introduction of setons beneath the skin, &c., are by some authorities looked upon as useful criteria in this way, as they give rise to a peculiar unhealthy action in the tissues involved.*

* With regard to the long and uncertain period of incubation of this disease, the following instance is recorded by Lydtin (in the *Mittheilungen* for 1873), as occurring in Baden in 1871, where the malady assumed great dimensions during that and the following year, in consequence of the Franco-German war :—In the spring of 1871, a farmer at Donaneschingen bought a cast troop horse, which he kept until the end of the year, when he sold it to a knacker in consequence of disease. At the slaughter-house the veterinary inspector of the district found it to be affected with Glanders, and as it had cohabited with other horses belonging to the farmer, these were carefully inspected and discovered to be healthy. A second visit was made after two months' isolation, and there being no disease apparent the interdiction was removed, and the stable declared to be free from infection. In August, 1872, Glanders suddenly appeared among some young horses in a neighbouring pasture, and on inquiry it was found that the disease had been introduced by a foal belonging to the farmer whose horses were reported sound in 1871. These were now again visited and inspected, and three glandered animals were discovered. In the pasturage to which the malady had been introduced, it was found necessary, within a short period, to kill thirty-three out of the fifty-five foals grazing thereon.

The same authority also mentions that a horse, cast from a cavalry regiment which had made this campaign, was brought into the stables on the estate of Lœwenstein, Baden, in February, 1873. When this animal was recognized as diseased, it had already infected others; these were killed in April, and those which had been standing near them were isolated, and all the other horses were separated in pairs. The stables were carefully cleansed and disinfected, as were the harness, buckets, and stable utensils, and the horses were regularly inspected every week by the district veterinary surgeon. This inspection and isolation lasted for three months, and

EXTENSION.

Glanders and Farcy are diffused by actual contact of the diseased with the healthy, or through the agency of contami-

towards the middle of July, no new case of Glanders appearing, nor any symptoms to cause suspicion, the interdiction to movement beyond the estate was removed. Among the horses was one belonging to the steward; this was an aged animal, but lively, in good condition, and with a healthy coat. At one time it had a discharge from one nostril, but this had disappeared for several weeks, and it was not until August that it was again manifested from one nostril: being then slightly fœtid, and accompanied by swelling of the submaxillary lymphatic glands and a trifling cough. Nearly at the same time two other horses offered symptoms of sore throat, difficulty in mastication and swallowing, ptyalism, emaciation, &c. On a close inspection two of these animals, as well as two others in the same stable, were found to be affected with Glanders, and a necroscopical examination confirmed the diagnosis; as on the pituitary membrane, in the larynx, trachea, and lungs of two of them, were found the lesions of acute Glanders, and in the liver were caseous and calcified tubercles; while in all, the lymphatic glands of the intermaxillary space, and of the bronchia and mysentery were enlarged, sometimes congested, but exempt from tubercles. In this instance, the period of incubation was evidently four and a half months; the infection leading first to internal alterations, especially of the liver, and only at a later period those of the air-passages.

Zundel, of Mulhouse, also states that at Ensïsheim (Haut-Rhin), he saw three horses affected with Glanders in a stable where a horse had stood, and which had been destroyed for the disease eleven months previously. This animal had been cast from the German army. He also inspected several horses suffering from the malady at Hesingue; these became infected through cohabitation and contact with a horse that had belonged to Bourbaki's army, and which had been purchased in Switzerland. It remained in apparent good health and condition for nine months after the retreat into that country, before it showed signs of Glanders, for which it was killed in November, 1871. It was not until June, 1872, that two horses, one of which had cohabited, and the other had been frequently in contact with it, exhibited symptoms of infection.

Reech, of Colmar, has reported the infection of two horses through their inhabiting a stable where, more than a year before, two horses belonging to the German artillery had been lodged. These latter were from the batteries besieging New Brisach, among the horses of which were many suspicious cases.

It was noted at this period that there were many examples of what was termed "internal" or "latent" Glanders, in which a long time elapsed

nated objects ; for although we admit that the malady may be spontaneously developed, yet we must also confess that the majority of outbreaks can only be looked upon as due to contagion.

As a general rule, there must be frequent repetitions of contact of some kind or other, direct or indirect, before healthy animals become affected. And to speak from the experience afforded by long observation, the danger of infection, though by no means to be considered small, has nevertheless been much exaggerated, seeing that the contagium is fixed. Wherever the malady appears, it only manifests itself in isolated cases, rarely affecting more than one or two animals at a time, even when it has existed for a considerable period in a stable or large horse establishment. And in special instances, when it becomes more gradually diffused and epizoötic in character, it is noted that many horses prove refractory to its influence.

In addition to this, we have the fact that the malady for a time disappears, as it were ; though it is not extinct, and may break out in all its virulency months afterwards.

The disease generally appears among horses in large establishments, as omnibus, cab, posting, and waggon horses, those of cavalry regiments and batteries of artillery, and in stables into which many new purchases are introduced. Horse-fairs, auctions, and stabling horses in strange stables,

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before the malady was characterized by its three pathognomonic symptoms, although the organic alterations indicative of the presence of the virulent element—tubercles in the lungs—were found at an early period. These cases were remarkable for the readiness with which they could communicate the disease to animals cohabiting with them ; and they were all the more dangerous as they were less suspected. For a certain time they only showed symptoms of Asthma, a slight chronic discharge, and rarely ulceration of the nasal membrane : chancres, indeed, in this region were always but little apparent. Mandel had a horse destroyed which only showed some cicatrices on the pituitary membrane, and on dissecting it he discovered numerous miliary tubercles in the lungs. A Swiss veterinary surgeon had been treating this horse some months for chronic Bronchitis.

also tend to its extension. Fatigue, a diminished supply of food, bad forage, and other influences favour the dissemination of the infection ; and crowded close stables increase the danger of extension to the highest degree.

It is curious to observe how tenaciously the contagium clings to a stable-yard or a regiment when once it obtains a footing, unless the most careful preventive measures are adopted. In this country, not many years ago, Glanders and Farcy were extremely common diseases, both in civil and military stables ; and this prevalence was undoubtedly due to the little care exercised with regard to keeping horses healthy by attending to their stable management, and feeding them according to the labour exacted from them ; as well as to a belief that the malady was not contagious, and that it was curable. Now the disease is extremely rare in the army (something like four per cent.) ; and if it at times is very prevalent and destructive among the horses of towns and cities, this is only because there is not the same supervision nor sanitary measures adopted to prevent or suppress the contagion.

On the whole, however, the per-centage of cases of Glanders and Farcy is not very large ; though in this country we are unable to give any statistics in proof of this statement, no record of their occurrence having been attempted. In the kingdom of Saxony, however, according to Haubner, the annual average among the civilian horses during a period of ten years was ninety-seven, and in 1866, notwithstanding the war and its consequences, there were only one hundred and fifty-four cases ; giving, in an establishment of 105,000 to 107,000, only about one per thousand. After the late Franco-German war, however, the malady was widespread in France and Germany, and the per-centage must have been greater.

In Prussia, among 1,800,000 civilian horses, 1000 to 1300 cases occur yearly, being one in fifteen hundred ; though it is probable that this is rather below than above the number, as there is reason to believe that all the cases are not brought under the cognizance of the commissioners.

Among the French army horses, the annual loss rose to

forty per thousand at a time when the contagious nature of the disease was denied, and attempts at cure were made. From 1846 to 1853 inclusive, out of a total of 438,157 horses, there died from, or were destroyed for, Glanders, 10,437 or 23·8 per cent., and for Farcy 660, or 1·5 per cent. In 1862, in every thousand of the effective horses, there were 9·264 cases of Glanders, and of Farcy 0·772.

When the disease extends as an epizoöty, as it did in France in 1766, 1807, and 1808, in Holland in 1836, and in the French and German armies in 1812, then the average is immensely increased and the contagium most virulent.

We have already remarked that the disease is extended in a diversity of ways, all of which are more or less efficient; and remembering what we have said concerning this, it is not necessary to add more in this place. It may, however, be stated that the extension of Glanders and Farcy is increased, in proportion as preventive or suppressive measures are wanting or not enforced, or attempts at a cure are made.

It must ever be remembered that the malady is easily concealed, particularly in the chronic form; and that it is readily introduced into a stable or a locality, where it may linger for years if not energetically dealt with. The risk of infection is increased from the fact, that *apparently* healthy horses can contaminate those which are healthy; and the pecuniary loss inflicted by the disease may eventually become very serious, even if only a comparatively few cases occur.* All this causes

* A striking instance of one of these obscure, though dangerous cases, is given by Lafosse, who, with two other veterinary surgeons at Castres, witnessed it. An aged gray mare was sold three times within two months, and in each of the three stables it inhabited, it communicated acute or chronic Glanders to horses, mules, and asses. The third purchaser instituted an action for damages against the last vendor, and the animal was examined. The cicatrices of ulcers were found on the pituitary membrane, and there was a scar on the skin of the intermaxillary space, due, no doubt, to attempts at extirpation of the indurated glands. The justices ordered the animal to be killed and carefully dissected. Only these cicatrices and thickening of the nasal membrane, and a few miliary tubercles in the lungs, were discovered—all old lesions. And yet this horse readily infected others which cohabited with it.

the malady to be justly dreaded ; and gives to it an importance which is greatly increased, when we know that our own species are exposed to the danger of perishing from this most loathsome and incurable disorder.

MORTALITY AND LOSS.

This, if compared with the equine population of the country, is not considerable ; but when compared with the number of cases occurring, it is serious, a fatal termination resulting in nearly every instance. We have just referred to the per-centage of horses affected in a particular equine population, and this will give the mortality, which, in certain outbreaks, may be said to be high when it amounts to twenty-five per cent. of an establishment.

Of the mortality attending Farcy only, we cannot arrive at anything like a fair estimate ; as in the statistics now and again published, it is evident that an accurate diagnosis has not been established. According to Goux, the mortality from chronic Farcy among the horses of the French army is only eight or nine per cent., but Gillet fixes it at eighteen to twenty.

In the preceding section, some details have been given with regard to the mortality attending the disease in horses. In the human species, the annual loss of life in some countries from infection is not insignificant. In Ireland alone, for instance, in 1851, there were, according to the report of the registrar-general, no fewer than 196 cases, entire families being involved.

IMMUNITY.

There is no evidence to show that one attack of Glanders or Farcy will confer immunity from another, in the equine species ; indeed, it must be difficult to arrive at such a conclusion, for the reasons already stated.

It may be noted, however, that Saint-Cyr's experiments demonstrated that a dog which had recovered from the effects of glander-inoculation, was not again susceptible to the action of the virus ; and as proving the "unicity" of the poison, he shows that we may inoculate a horse suffering from chronic

Glanders with the virus from an acute case, without producing more than an imperfect pustule at the point of inoculation.

SANITARY MEASURES.

The sanitary measures for the prevention and suppression of Glanders and Farcy are of great importance, seeing the contagiousness of these two forms of the same disease, and the serious consequences that may follow the propagation of the contagion.

PERMANENT PRECAUTIONARY MEASURES.

In a country where the malady has not appeared (such as Australia), but into which it may be imported, of course everything depends upon the care with which new arrivals are examined, and suspicious cases isolated, until a decision as to their condition can be safely and certainly given. In these suspicious cases, the isolation must be as complete as possible; and every precaution ought to be observed, so long as there remains any cause for doubt. It is desirable that the ports by which horses or other solipeds are admitted be defined, so that this inspection may be assured.

PREVENTIVE MEASURES.

Recognizing the efficacy of certain known influences in producing the spontaneous development of this disease, or accelerating its evolution, it is evident that a due observance of the laws of health, and the judicious management of horses, must occupy the first place on the list of preventive measures. The most notable of these influences we have already enumerated.

In addition to attention being paid to the avoidance of unfavourable influences, the State should endeavour to enlighten those chiefly concerned as to the symptoms presented by a suspected or diseased animal, the danger resulting from contact with the infected, the precautions to be adopted to avert inoculation, and the mode of fulfilling the duties prescribed by the law when the disease is discovered to be present, or its existence is suspected.

All discharges from the nostrils, no matter how trifling they may appear, should not be considered as unimportant, particularly if Glanders is known to exist in a locality or district; and an inspection of the animals so affected ought to be made by a competent veterinary surgeon. Until this inspection has taken place, the suspected horses should not be allowed to associate with others either at work or in stables.

If there is any reason to apprehend the existence of the disease in a district or county, the horse-fairs and markets should be visited by properly qualified persons, and all affected animals must be killed without delay; while the suspected, and the stable in which they have stood, and clothing they may have worn, as well as the stable utensils, must be submitted to certain prescriptions, which will be alluded to presently.

The local authorities should more particularly direct their attention to the horses* of petty jobbing horse-dealers, knackers, and others; and a veterinary surgeon ought to be detailed to visit their establishments frequently, as well as public stables—those of inns and hotels—and other places where diseased or suspected horses might be lodged.

If the malady is prevalent in a county or district, inn, hotel, and livery stable-keepers ought to be careful in admitting strange horses into their stables, assuring themselves as to their freedom from suspicious symptoms before permitting them to enter. If any animals exhibit signs of the disease, the circumstance should be reported without delay to the proper authorities. All stables should be kept well-ventilated and clean; and once a week, or even oftener, the mangers, racks, and other parts of the stalls most exposed to become soiled by diseased horses, should be well cleansed. Water troughs should also receive attention.

* In the term "horses," in this section, is of course included all animals susceptible of the disease.

SUPPRESSIVE MEASURES.

1. *Declaration.*

When Glanders and Farcy are prevalent, every horse-owner who suspects the existence of disease, should be compelled, under a penalty, to declare the same without delay to the authorities: keeping the animals apart from healthy horses in the meantime, and not allowing them to work, graze, or be stabled with others, supposed to be healthy, nor moved by road, rail, or boat until an inspection has been made. Veterinary surgeons and others should also be charged to report the existence, or suspected existence, of the disease in any horse they may see or be called upon to attend professionally.*

A heavy penalty should be inflicted on any person who exposes for sale, sells, works, or travels on the public road, a horse affected with Glanders or Farcy; and a penalty of some severity should attach to the concealment of the malady, and more especially as its existence is very rarely reported.

The sanitary authorities or veterinary inspectors should have the power allowed them to enter any stable or other place where the disease is suspected to exist: this power being conferred either by a special Act of Parliament, or by a magistrate's warrant.

2. *Occision.*

The horses found by the veterinary inspector to be unmistakably affected with Glanders, should be destroyed as quickly as possible; those suffering from Farcy in a mild degree may be submitted to medical treatment, if the cases are deemed favourable, and other circumstances are auspicious; but this should only be attempted with the sanction of the authorities,

* In France, a decree of 1784, having reference to this disease, not only authorizes fines and imprisonment for those who infringe the law; but also sanctions the practice of informing on those who transgress, ordaining that the denouncer be recompensed by receiving one-third of the fine imposed.

and under the surveillance of some competent person, who will be responsible for the carrying out of every necessary sanitary precaution. Should the Farcy have attained a certain degree of severity, or there exist reasons for suspecting a general infection, the animals ought to be killed.*

3. *Compensation.*

Owners of glandered horses so destroyed, may receive compensation ; but considering that the malady is incurable, and that the life of the owner, of his servants, or that of other individuals, is in danger, the amount need not be much more than the value of the animal's carcass. Certain exceptional circumstances may, however, justify awarding a higher compensation : as in mild cases of Farcy, in which the animal's ser-

* By an Order of Council, which came into operation on July 2, 1873, Farcy is included among the contagious diseases of animals recognized by law in Britain. Glanders was included in the general Order of August, 1869, which is quoted at the end of the second volume. The July Order says :

" Farcy is hereby declared to be a contagious disease, for the purposes of the Act of 1869, and all the provisions relating to contagious or infectious disease contained in any Order of Council for the time being in force thereunder shall also apply to Farcy. Where a local authority is authorized by the Privy Council to make regulations for the purpose of preventing the spreading of Glanders and Farcy, or either of them, the local authority may make regulations for the following purposes or any of them : For prohibiting or regulating the movement out of any field, stable, shed, or other premises in which Glanders or Farcy have been found to exist, of any horse that is or has been affected with Glanders or Farcy, or that has been in the same field, stable, shed, or other premises with, or in contact with, any horse affected with Glanders or Farcy."

The committee on the Contagious Diseases (Animals) Act, in August, 1873, recommend that the slaughter of horses affected with Glanders should be compulsory, but that payment should be made to the owner for the value of the carcasses.

The Orders in Council have proved perfectly ineffectual in suppressing Glanders and Farcy, the disease being now, October, 1874, extremely prevalent among omnibus, cab, and other horses ; and many of these work, especially by night, in the public thoroughfares.

The horses of petty cab-owners are, perhaps, most frequently affected. No attention appears to be paid to the Orders relative to Glanders and Farcy ; but these Orders are unsatisfactory and incomplete, and even if carried into effect would not suppress the contagion.

vices could be made available for a more or less lengthened period; and compulsory slaughter may even at times be justifiable without offering compensation, as when the owner has not declared the existence of the disease immediately it was observed.

4. *Isolation.*

Horses presenting suspicious symptoms of either Glanders or Farcy should be carefully sequestered and, if deemed advisable, submitted to medical treatment until either the pathognomonic indications of the malady have manifested themselves, or they are declared uninfected. During this time they must remain under the observation of the authorities, and be attended by men who do not look after other horses. The stable and other utensils used for suspected horses, must not be utilized elsewhere until thoroughly cleansed and disinfected.

5. *Inspection.*

Horses which have been in contact with others suffering from Glanders or Farcy, or which are suspected in consequence of cohabitation with them, if they do not exhibit any symptoms of disease, should remain under veterinary surveillance for a certain period, which must not be less than twenty days, and may even be extended to six months. During the shorter period they ought to be frequently inspected—at least once a week, and for the remainder of the time every two or three weeks. For the twenty days, they should not be allowed to mix with other horses; but if, after that time, they remain in good health, they may be used in the locality until all apprehension of danger has passed away.

6. *Sale.*

The owner may dispose of such horses during this period, if they continue free from the disease, but the sale should not be permitted without the authorities being duly informed; these will warn the purchaser of the state of affairs, and give him to understand that the animals are still under veterinary inspection.

During the first two months, these horses should not be placed in any public or private stable other than their own; and they must not be allowed to make distant journeys, nor be sent beyond observation. Whenever any suspicious symptom becomes manifest in these animals, then strict isolation and other precautions must be enforced, until a precise diagnosis can be formed.

Should Glanders or Farcy be discovered among horses when in another district, away from their own home, the authorities of the locality in which their owner resides should receive an intimation of the fact, in order that they may visit the other horses in the place, and if necessary devise appropriate measures.

If several cases of Glanders and Farcy are discovered in a locality, all the horses therein should be inspected, for the purpose of ascertaining the extent to which the malady has been propagated, and prescribing the necessary measures. These inspections may be repeated as often as circumstances may demand, and suspected horses may receive a particular distinguishing mark.

7. *Carcasses of Horses.*

The carcasses of horses which have died or been destroyed, should be buried in an appropriate place, at a safe depth, and after the skin has been freely slashed to prevent its being disinterred. This interment is a judicious measure, and is all the more imperative if the animals have died from the disease; as there is then more danger, and the value of the carcass is greatly diminished.

If, however, the carcass is allowed, by special authority, to be utilized by the knacker, the horse may be conducted to his establishment at a certain hour of the day or night, and with every precaution; or its carcass, after disinfection, may be conveyed in a proper carriage or waggon. The cases of inoculation from handling the *débris* of glandered or farcied horses are numerous; and it is, therefore, urgently necessary that the knackers be most careful in guarding against infection. They should have no sores or abrasions on their hands,

and the animal's skin should not be removed until the carcass is perfectly cold. In skinning and cutting up the body, the greatest care should be taken to guard against wounds or punctures, and it would be well to wear gloves on the hands.

When the skin is removed, it should be hung up for at least fifteen days in summer, or a month in winter, in a place exposed to the air and sun, and then allowed to pass into the hands of the tanner ; or if not so exposed, it must be steeped for at least twenty-four hours in lime-water. The flesh, tallow, and bones we will refer to immediately.

8. *Disinfection.*

The disinfection of stables and horse-equipment is a most important measure in the suppression of Glanders and Farcy.

Air and sunlight should be freely admitted, if possible; and if the stables are lofty and large, the walls should be scraped and lime-washed to a height of at least eight or ten feet. It may happen that, in a stable of this description, only one glandered or farcied horse has been present ; and in such a case, treating in this way the stall which it occupied, as well as that on each side, may suffice. It must be observed, however, that the most scrupulous precautions should be adopted, and that it is always best to err on the safe side. Partial cleansings are not always the most satisfactory in the end, and it will generally be most profitable to disinfect the entire stable.

Small stables containing but few horses should be completely lime-washed. All wood and iron work belonging to the stables, whether movable or fixed, and likely to have been in contact with the diseased, must be cleansed with boiling water, afterwards brushed over with quick-lime, and exposed to the air for at least eight days before being again used. The utensils and other articles used with the infected animals—buckets, brushes, head-collars, blankets, brooms, &c.—being generally of little value, should be destroyed by fire. Those which it is desirable to preserve should be cleansed as above ; iron objects may be passed through the fire.

If the floor of the stable is paved, it should be well scrubbed with boiling water and quick-lime by means of old brushes ;

the soil or cement between the stones or bricks, and which may be removed by this operation, should be replaced by new material. Should the floor consist merely of earth, the surface soil to the depth of at least six inches must be taken away and buried, and replaced by new soil.

After this treatment has been carried out, disinfection, by fumigation of sulphur or other chemical agent, should be carried out, the stable of course being empty and the doors and windows closed. After which it should be freely opened to the air, and not inhabited for at least eight days.

Stables of a temporary character which cannot be properly disinfected, should be pulled down and the materials of which they are composed burned or buried. Manure and forage from the infected stables should be treated in the same way.

Harness and other articles that have been in contact with the diseased, and which it would be a serious loss to destroy, are to be scoured in very hot water, and exposed to the sun and air for ten or twelve days.

This cleansing and disinfection should be carried out under the supervision of the authorities.

If, in a certain district, Glanders and Farcy prevail extensively, these measures must be all the more promptly and energetically carried out. A strict watch must be kept upon knackers' establishments, to discover whether diseased horses which have not been reported are received there, and if so, whence they came; and the knackers and horse-slaughterers should be compelled, under a penalty, to give information of these occurrences.

It is difficult to decide when the disease may be said to be extinct in a locality which has been infected. Röll is inclined to give a period of fifteen days after the last case of death or recovery, provided all the animals in the place are found to be healthy on final enumeration, and all the contaminated stables have been disinfected; but after what we have said as to the incubation of the malady, it can scarcely be denied that this interval is too brief.

PRECAUTIONARY MEASURES FOR PEOPLE.

The importance of framing some precautionary measures for people who, by accident or profession, may chance to be exposed to contact with glandered or farcied horses, cannot be overrated, when we remember the facility with which mankind can be inoculated, the loathsome character of the disease so induced, and its almost invariably fatal termination.

In the first place, those who have the care of diseased creatures, or are likely to be brought into contact with them —veterinary surgeons, surgeons, medical and veterinary students, coachmen, grooms, knackers, &c.,—should be fully alive to the risks they incur, with a view to be on their guard against inoculation: which is likely to occur if the Glander virus reach any part of the body where there are wounds or abrasions, or even where the epidermis is thin and soft. The eyes, nose, and lips are dangerous parts in this respect.

Persons who have wounds, ulcers, cracks or excoriations on their skin, and especially on the hands, arms, and face, should have nothing to do with Glander or Farcy patients; and if by accident they receive an injury of this description, they ought to abstain from attending on them.

The discharge from the nose, or from the Farcy ulcers, should not be removed with the naked hand or any article likely to convey it accidentally to the person (such as a handkerchief or towel), but with a sponge and plenty of water; the first being carefully rinsed afterwards and laid aside for this purpose only, and the water thrown into a drain where no animal can reach it.

Care must also be taken that the animal does not snort or sneeze the nasal discharge over the face or hands, or indeed on any part of the body. Should such an accident occur, the matter must be removed with the greatest solicitude, and at once. The same precautions must be used with regard to the other secretions, or in fact anything proceeding from a diseased or suspected horse, as all may serve as a vehicle for the virus. Neither must the expired air of such an animal be directly inhaled.

The mediate transmission of the virus in other ways should also be avoided. Articles impregnated with the contagium—such as blankets, head-collars, halters, &c.—should not be handled until cleansed and disinfected. Neither should the attendants or any other person sleep in the stables containing diseased or suspected horses, nor yet remain in them longer than is absolutely necessary; after contact with them and infected articles, the hands should be washed thoroughly with soap and water, or a very weak solution of hydrochloric, carbolic, or acetic acid.

People who have to attend such animals should be attentive to these sanitary precautions, and well-behaved; they ought to be cleanly in their persons and steady in their habits, of a good constitution, and in vigorous health. They should resort to the open air as frequently as their duties will permit, and live well.

The stables in which the sick or suspected are kept, ought to have as pure an atmosphere as possible—be well ventilated and kept clean—and should contain as few animals as circumstances will allow.

Reynal recommends that in authorized infirmaries, as well as in those attached to cavalry barracks, veterinary schools, and large horse establishments, those in charge of the sick or suspected should have a room that does not communicate with the stable, the necessary surveillance taking place through a glazed window; no articles which have served to dress the horses should be deposited in this chamber.

All wounds, punctures, or abrasions made while manipulating or dissecting the diseased, should be immediately cleansed and cauterized. The dissection of such animals should not be proceeded with until the carcasses are perfectly cold. The dressing of Glander or Farcy ulcers must be circumspectly conducted, and forceps should be used.

The clothes worn by persons attending sick or suspected horses should be kept scrupulously clean; those of people who have died of Glanders, as well as their beds and bedclothes, should be destroyed or thoroughly disinfected.

If any person who has been in contact with a glandered

horse perceives any part of his skin—and especially that on the hands or face—to inflame or ulcerate, or should he feel unwell, he ought to apply at once to a physician.

Those who administer medicines, dissect, or cut up diseased animals, must be particularly cautious in avoiding inoculation.

CURATIVE MEASURES.

It may almost be affirmed that Glanders and Farcy belong to the absolutely incurable diseases, and more particularly the former, as nearly every case has a fatal termination. It is, therefore, to be insisted upon that the curative treatment of confirmed Glanders ought not to be attempted; and that as soon as its existence is fully established, the horse should be immediately destroyed, in order to avert the chances of its transmission to man and other animals.

The extremely meagre and uncertain success attending medical treatment, the danger of contagion to man and other creatures, and the expense of medicine and forage incurred while endeavours are made to effect a cure, preclude all attempts in this direction; except those of an experimental kind, carried out in veterinary schools under proper supervision.

The cases of apparent recovery from Glanders and Farcy are scarcely more than five per cent., and the highest estimate has never placed them beyond ten per cent., and of these there have doubtless been a large proportion of relapses, even after months or years. There have been charlatans who pretended to cure Glanders, but they knew nothing of the malady; and their reported successes have been dearly purchased in the spread of the disease and the consequent loss.

It is not to be asserted, however, that every case of Farcy is incurable. I have witnessed several recoveries, and no doubt other veterinary surgeons of any experience will be ready to avow the same. But these recoveries have generally taken place among young and vigorous horses in which the malady was not evidently generated, but induced by contagion. Good diet; careful stable management; cleanliness; caustics, stimulants, and escharotics to the chancres, and particularly

the actual cautery; and blisters or mercurial applications to the enlarged lymphatic glands, with the internal exhibition of tonics, has generally been the curative treatment most successfully employed.

THE FLESH OF GLANDERED ANIMALS AS FOOD.

In describing the mode of access of the contagium of Glanders to the organism, in order to produce infection, allusion was made to the fact that the stomach is one of the channels by which the poison will enter the blood; and instances were cited to prove that the uncooked flesh of diseased horses had produced the malady in animals which had fed upon it. Seeing that horse-flesh is rapidly becoming an article of food for the human population on the continent of Europe and elsewhere, and that it may before long appear as an article of diet in this country, when the unreasonable prejudices which at present prevail against its use are dispelled by necessity or common sense, it is necessary that this fact should be borne in mind.

That raw flesh will communicate the disease when ingested as food, is clearly established; and it is also as distinctly proved that the flesh of glandered horses, when thoroughly cooked, loses its dangerous properties. There are numerous facts to support this; but one of the most striking, perhaps, is that which was noted in 1815, when the inhabitants of Charenton (near Paris) and the neighbourhood, consumed the flesh of a great number of glandered horses which were killed in the Bois de Vincennes, and no ill effects were reported.

Notwithstanding the innocuousness of the cooked flesh of glandered horses, its consumption as food by human beings ought to be interdicted; and if allowed to be given to dogs or other animals, care should be taken that it is thoroughly disinfected by boiling for a sufficient time.

To prevent fraud and the dangerous consequences which might result from introducing this flesh surreptitiously into the market, the authorities must be held responsible. All horses destined as food for people, should be inspected by a specially appointed and thoroughly competent veterinary

surgeon, before and after slaughter. If found to be in a healthy condition, the hoofs should receive a special mark by burning (to imitate which would be fraud), and these should remain attached to the carcass in the butcher's stall or shop, as evidence of the soundness of the flesh. Any carcass found without the hoofs, or with these unmarked, should be condemned as uncertified, and therefore unsafe.

The alterations by which the carcass of a horse that has been affected with Glanders may be distinguished, have already been described when treating of the disease itself. It may here be briefly stated that it is in the lungs, the mucous membrane of the head, and the lymphatic vessels and glands that the most characteristic features of the disease are to be found.

END OF VOL. I.

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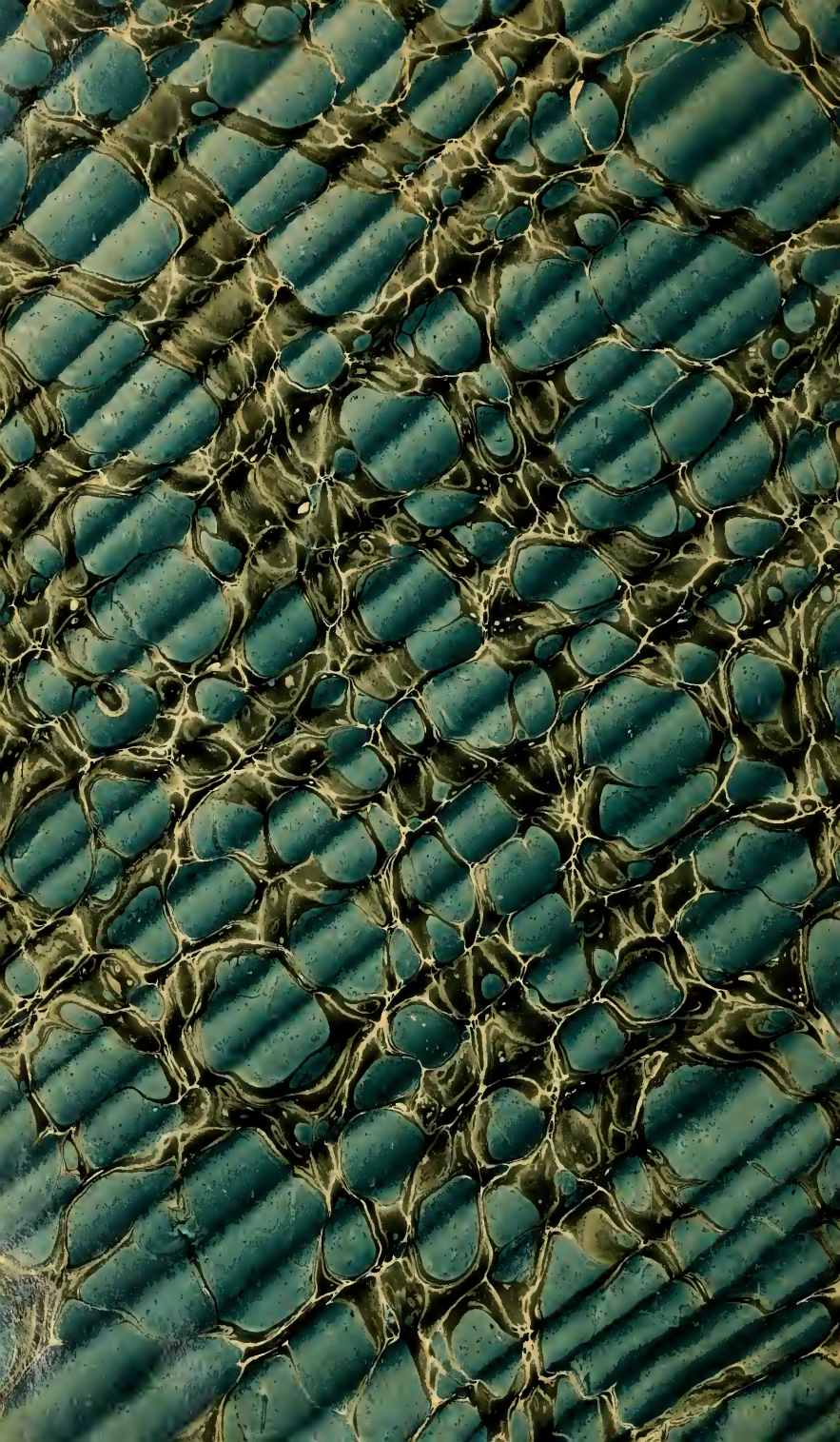
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